Institut universitaire romand de Santé au Travail
Institut für Arbeit und Gesundheit
Institute for Work and Health

« Nanoinventory »

"Assessment of the usage of nanoparticles in the Swiss industry by letter survey"

Intermediate report: a representative survey by letter

Kaspar Schmid, Brigitta Danuser, Michael Riediker
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Institut universitaire romand de Santé au Travail
(Institute for Work and Health)
Rue du Bugnon 21, 1005 Lausanne
Tel. +41 (0)21 314 74 21

General addresses and contact information for the „nano-inventory“

General address
Institut universitaire romand de Santé au Travail
Rue du Bugnon 21
1005 Lausanne
Switzerland
Tel. +41 (0)21 314 74 21
Fax . +41 (0)21 314 74 30
www.i-s-t.ch

Nano-inventory - leader
Michael Riediker, Dr.sc.nat.
Head "Group Particles and Health"
Institute for Work and Health
(IST = Institut universitaire romand de Santé au Travail)
Rue du Bugnon 21
1005 Lausanne
Switzerland

Tel. direct +41 (0)21 314 74 53
Fax . +41 (0)21 314 74 30
Michael.Riediker@hospvd.ch

Nano-inventory - staff
Kaspar Schmid, MSc
Institute for Work and Health
(IST = Institut universitaire romand de Santé au Travail)
Rue du Bugnon 21
1005 Lausanne
Switzerland

Tel. direct +41 (0)21 314 74 15
Fax . +41 (0)21 314 74 30
Kaspar.Schmid@hospvd.ch

Director of the institute
Brigitta Danuser, Prof.
Institute for Work and Health
(IST = Institut universitaire romand de Santé au Travail)
Rue du Bugnon 21
1005 Lausanne
Switzerland

Tel. direct +41 (0)21 314 74 22
Fax . +41 (0)21 314 74 20
Brigitta.Danuser@hospvd.ch

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http://www.seco.admin.ch/index.html?lang=en

Swiss accident insurance
http://www.suva.ch/en/home_en.htm

French Agency for Occupational and Environmental Health Safety
http://www.afsse.fr

We also would like to express our tank to all the persons in charge in the interviewed companies for their kind responses and the clinical epidemiology centre (CepiC, university of Lausanne) for the statistical support.

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1. Description of the "Nanoinventory"

Background

Nanoparticles (smaller than 100 nm in at least two dimensions) are interesting for industrial and medical applications since they have properties, which are different from those of the same substance at larger size. A large number of different types of nanoparticles and applications are currently being developed and introduced into industrial processes and consumer products (Chaudhry and others, 2005).

Exposure to micro- and nanosized particulate matter (PM) from air pollution is associated with negative health effects such as physiological reactions in the lungs, pro-inflammatory and pro-thrombotic vascular responses, and interferences with the cardiac rhythm. Manufactured nanoparticles might cause similar responses (Hoet, Bruske-Hohlfeld, and Salata, 2004).

There is an urgent need to evaluate the risks of these particles to ensure their safe production, handling, use, and disposal. The knowledge about the number of occupationally exposed people in Switzerland as well as the type and quantity of such an exposure is insufficient for risk assessment purposes (Meili and others, 2007).

Specific aims

This study has the goal to identify the processes, professional sectors and companies in Switzerland, in which nanoparticles are applied.

Study design in a larger context

As long as there is a lack of solid exposure data no solid risk evaluation can be done. Studies on toxicological effects need to be combined with information about real exposure to provide information about the real world situation. Therefore the basic objective of this thesis is to evaluate the exposure of the Swiss working population to engineered nanoparticles.

We will create a quantitative model of the occupational exposure to manufactured nanoparticles in Swiss industry to provide a basis for a risk assessment.

We chose a study design, which combines an inventory with workplace measurements: The “nano-inventory” provides information about the number of potentially exposed people and their type of exposure, while a series of measurements in representative companies will provide information about the real exposure concerning different exposure-types. The combination of the two approaches allows estimating an occupational exposure to nanoparticles in Switzerland, based on facts.

Steps of the study

a) A **telephone survey** of about 200 companies was conducted to evaluate the prevalence and level of nanoparticle use in the Swiss industry as well as the potential for exposure of the Swiss working population to engineered nanoparticles. This step is already finished and it showed that the use of nanoparticles is reality in the Swiss industry. Several types of nanoparticles were used in quantities of more than 1000 kg/year in a company, but the majority of nanoparticle applications were small production scale. Most of the companies had many open questions about best practices: guidelines and protection strategies should be developed soon.

b) **Representative survey**: Based on the results of the telephone survey we formulated this, here presented, detailed and representative survey. It is a questionnaire-based estimation of the potentially exposed employees asking about "substance, form, quantity, purpose of application, form at delivery, manner of handling, number of concerned persons, protective equipment, information politics in the company, direct impact on environment.
   It will be completed with information about the real exposure by a workplace exposure assessment in selected companies and for selected application types.
c) **Measurements**: In selected companies the real exposure of employees will be measured with a condensation particle counter. The companies are chosen by means of particle type, application type, protection type and handling differences to represent the most occurring exposure to nanoparticles.
d) **Model**: These potential/representative and real/selective datasets will be used to build a model of the distribution of occupational exposures to nanoparticles in Switzerland.

2. Methods

2.1. Survey design and mailing procedure

The survey by mail was based on 1626 companies and was realised in collaboration with, and mandated by the Swiss Federal Offices for Health (FOPH), Environment (FOEN) and Economy (SECO), the Swiss National Accident Insurance (SUVA) and the French Agency for Environmental and Occupational Health and Safety (AFSSET). It is representative for the Swiss work force, given that they are well represented by the SUVA-Client list: Switzerland has totally about 300'000 companies[1], which are submitted to an obligation by law to cover their employees against occupational accidents. The predominant assurance company is the Swiss National Accident Insurance (SUVA) - about 100’000 companies are SUVA-clients, but, which is particularly interesting - most of the companies of the producing sector are. We compared the SUVA-client size distribution with the official census of enterprises 2005 to show the similarity of all SUVA-clients to the totality of Swiss companies.

Building layers

To increase the power of the survey we used the approach of a layered survey. The statistic plan has been elaborated in collaboration with the centre of clinical epidemiology (CepiC) in Lausanne. The layered survey was built in the size of 1900 companies, randomly chosen in 21 layers (this corresponded to 1.77% of all clients of the SUVA): the companies would be interviewed by a written questionnaire concerning their activities handling manufactured nanoparticles with regard to types and quantities, protective measures and numbers of potentially exposed workers.

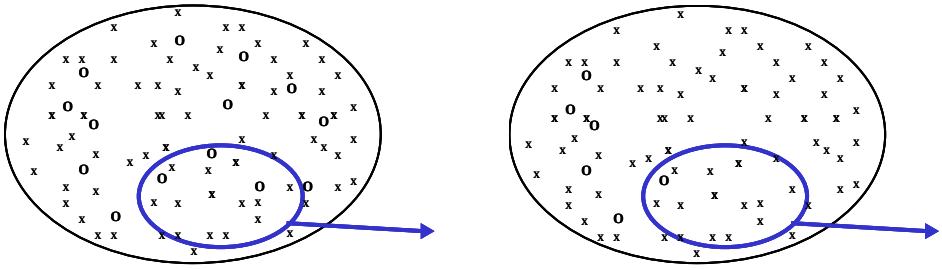


Figure 1: Symbolic scheme of a simple randomised survey. The simple randomised survey does not necessarily reflect a good sample, if the distribution is inhomogeneous.

1: Federal Statistical Office (FSO)
http://www.bfs.admin.ch/bfs/portal/de/index/infothek/inv_reg/02/10.html

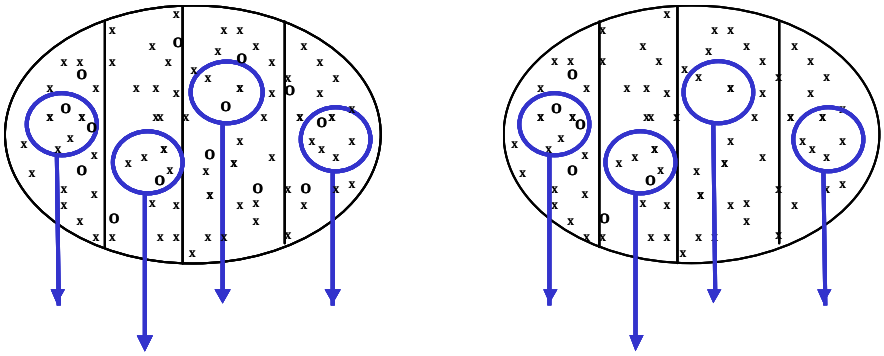


Figure 2: Symbolic scheme of a layered survey. If the distribution is inhomogeneous, a layered survey can provide more accurate information than a non-layered.

The layered approach was chosen to have a good representation of the expected inhomogeneous distribution of the nanoparticle applications between different economic sectors. The gained information about the occurrence of nanoparticles in industry can be allocated to an economic sector. However, the more layers you create, the less powerful the statistic for each layer will be for a predefined sample size. We therefore limited the study to 21 layers. One layer consisted of one or several economic sectors that were closely related. In each layer, companies were randomly selected. The respective numbers were proportional to the size of the layer with a minimum of 50 companies per layer.

After a panel of four experts indicated a very low likelihood that some sectors used or produced nanoparticles, we excluded a whole layer of the analysis, it concerned following sectors: economic and technical offices, administrations, travel service and shops, governmental administration, post offices, employee placements, programs for temporary occupation of non employed (SUVA-codes: 60F, 61A, 70C and 71A). The exclusion of the one layer has been done after the calculation of the statistical plan and reduced the 1900 initially calculated and planned to 1626 effectively sent letters. As the layers were handled separately, the exclusion of one layer did not affect the statistical power. The survey represented finally 2.07% of the SUVA clients without these excluded sectors.

The random selection of companies (n_h) in each of the layers was proportional to the size of the layers (N_h):

$\frac{n_h}{N_h} = \frac{n}{N}$, with n and N corresponding to the number of total letters (n=1900[2]) and the number of total companies being clients of the SUVA (N = 91804[3]).

The number of selections per layer was: $n_h = \frac{n \cdot N_h}{N}$

The numbers smaller than 50 have been replaced by 50. $\begin{cases} m_h = 0, if\ n_h > 50 \\ m_h = 1, if\ n_h \leq 50 \end{cases}$

[2] 274 of these 1900 companies (one layer) have been excluded from the mailing.

[3] The exclusion of the layer reduced the number of corresponding SUVA clients from 91804 to 78559 companies.

A re-evaluation of the number of selected companies in the layers larger than 50 was necessary. We created the values n_{new} and N_{new} corresponding to the number of letters and number of total companies for the concerning layers with values n_h bigger than the minimal 50 to become:

$$n_{new} = n - \sum_{h=1}^{H} \left(m_h \times 50 \right)$$

and

$$N_{new} = N - \sum_{h=1}^{H} \left(n_h \times m_h \right)$$

Finally the size of the selection per layer (n_h^*) was given by

$$\begin{cases} n_h^* = \dfrac{n_{new} N_h}{N_{new}}, if\ m_h = 0 \\ n_h^* = 50, if\ m_h = 1 \end{cases}$$

Two additionally surveyed groups

The approach to group several branches into layers bears the potential risk that some smaller economic branches may be overlooked, especially when it is a small economic branch in a big layer. Also, the 100 largest companies employ about 400'000 employees (or 21.9% of the total SUVA assured employees)[4] but only few of these companies would be included in a random sample.

These two aspects were accounted for by an additional survey of the top-100 companies in terms of number of employees (exclusive financial institutions, see annex Table 3), and a survey of selected sectors, which we found to be statistically underrepresented in the layered sample.

Information letter to 24 industrial associations

We sent a letter to 24 Swiss industrial associations informing them about the plan to do a survey. We informed them about the aim of the study and sent them a provisional version of the questionnaire, allowing them to respond to potential questions by their members. The considered associations are listed in the annex Table 4.

Building the questionnaire

We built a questionnaire consisting of three parts:

- The first page asked general questions about the company/organisation and the question if *yes* or *no* they were using, producing or liberating sub/µm-particles.
- The second page asked general questions about the used particles in terms of particle composition, particle size, stock size and transport frequency. Furthermore asking general questions about the responsibility policy of the company concerning the handling of particles.
- The third page focussed on the process of nanoparticle handling, asking about the characteristics of the used nanoparticles in this process, the manipulations

[4] According to the SUVA client database: the selection of the top-100 companies corresponds to 408'856 of the total 1'866'077 100%-employees assured by SUVA.

during the process, the yearly turnover, the used protection means, and the waste treatment.

The questionnaire allowed the respondents to define several applications, in the case of different locations and individual production methods or protection means. A copy of it is presented in the annex (Figure 14 to Figure 16 in German, Figure 17 in French and Figure 18 in Italian).

Finally the questions were compared to the questionnaire of the German BAUA (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin)[5], and the formulation of some questions were slightly adapted to facilitate a comparison of results.

Sending the questionnaires

The questionnaires were sent in February 2007 to a total of 1920 companies (1626 to the layered selection, 99 to the Top-100 and 195 additional ones to the underrepresented sectors).

This triple approach has been chosen to give a good overview about the usage of manufactured nanoparticles in the Swiss industry and to provide insight into occupational hygiene and environmental approaches for nanoparticles by the answers of the concerned companies. This insight will be useful for a later risk assessment.

Sending a reminder letter to the non respondent

A reminder letter was sent in July 2007 to the non-responding companies. At that moment, 38% of the companies had responded. The reminder contained again a copy of the questionnaire.

2.2. Quality tests

Data entry

Data entry of a survey can be a source of errors. We first entered the data by hand typing, using Epidata (freeware by the EpiData Association, att. Jens Lauritsen, Enghavevej 34, DK5230 Odense M, Denmark)[6] and checked electronically readable data subsequently by electronic questionnaire reading software Teleform (payware by Cardiff, Vista, 92081 California)[7]. For the forms, which contained information about nanoparticles we did a second hand typing instead of an electronic reading. This procedure allowed a comparison of the error rates and a calculation of the probability for remaining errors.

Verification of the answer "no" by phone

Any survey has a bias introduced by non-responders. Phone calls to a random selected subset are planned to gain information about the difference between the non-responding and the responding companies, and to verify that there was not a misunderstanding or other bias.

We calculated the number of companies needed to be checked, to obtain an acceptable low likelihood that the answer "NO" is not the consequence of a misunderstanding. We used S-Plus 7.0 for Windows Enterprise developer, Build 7187 to calculate the minimal necessary sample size with the formula

[5] http://www.baua.de
[6] http://www.epidata.dk
[7] http://www.cardiff.com/products/teleform/index.html

"binom.test". We then created a random sample companies responding "NO" foreseen to check with a phone call. The sample was made with 20% spare addresses, in case of non-successful contacts.
This quality test is not jet finished.

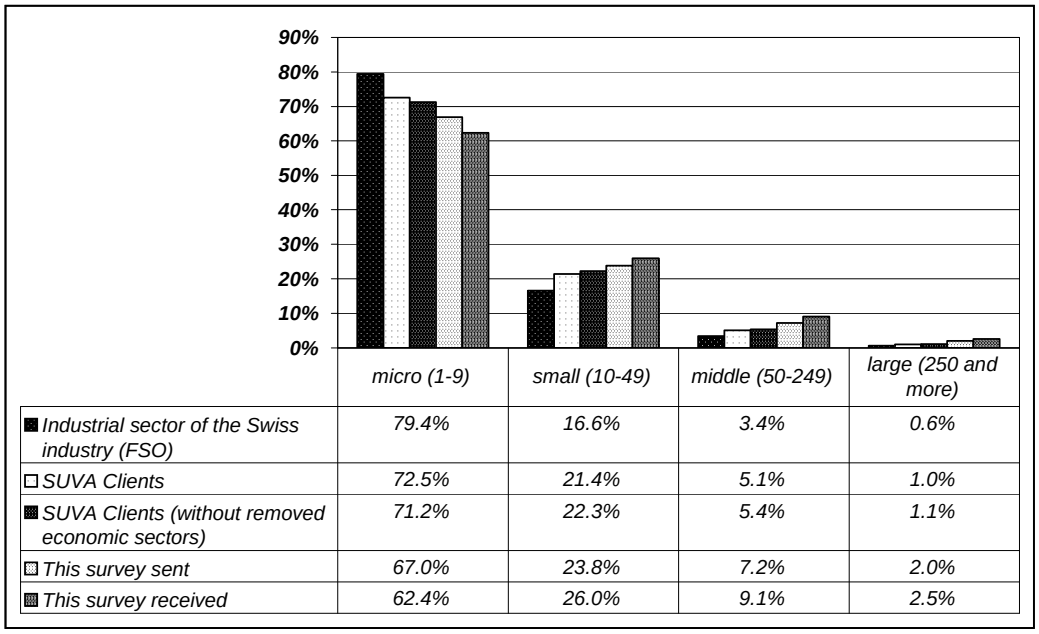
Verification of no-answer by a statistical approach
We used the SUVA client dataset about the size distribution (in number of 100% employees) of the responding and non-responding companies to test the similarity of the two groups in a Wilcoxon test. This provided the information to what extent the extrapolation from the subset to the entire group was justified.

3. Results

3.1. General results

3.1.1. Size of the companies

Figure 3 shows the size distribution in terms of number of 100% employees of the totality of Swiss companies (FSO)[8], the SUVA-client size distribution, as well as the size distribution of the layered survey sample and the one of the answering subset. This comparison shows the quality of the samples: in terms of the size the SUVA-clients represent a good sample of Swiss companies. This similarity is given for all subsets or samples (see Figure 3) with a slight shift from smaller to bigger companies in the layered sample and the responding part of it.



	micro (1-9)	small (10-49)	middle (50-249)	large (250 and more)
Industrial sector of the Swiss industry (FSO)	79.4%	16.6%	3.4%	0.6%
SUVA Clients	72.5%	21.4%	5.1%	1.0%
SUVA Clients (without removed economic sectors)	71.2%	22.3%	5.4%	1.1%
This survey sent	67.0%	23.8%	7.2%	2.0%
This survey received	62.4%	26.0%	9.1%	2.5%

Figure 3: Comparison of the size distribution of the totality of Swiss companies (census of enterprises 2005, FSO), the SUVA-clients, the layered survey sample and the one of the answering subset. The size distribution in terms of number of employees is about the same in all these sets.

3.1.2. Response rate

The average response rate of the layered survey was 58.3 % (or 948 of 1626 sent letters, for the response rate of each layer see Figure 4, and for a detailed description each layer see Table 5 in the annex). The two additional surveys showed a similar response rate to the layered survey: additional sectors responded by 66 %, the top-100 by 64 %.

[8] Census of enterprises 2005 by the Federal Statistical Office (FSO)

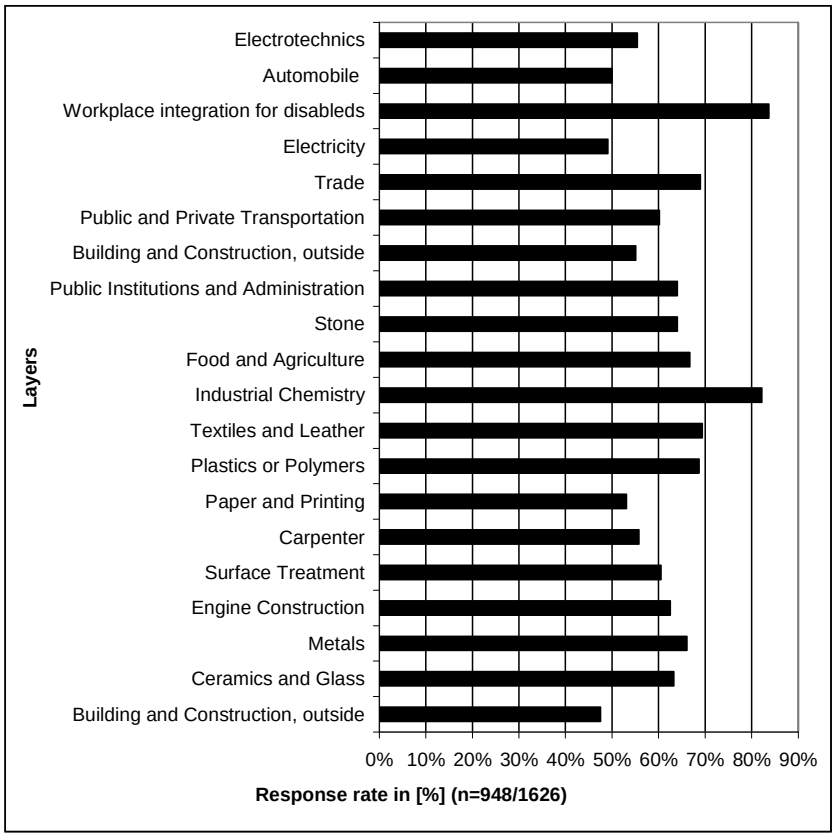


Figure 4: Response rate by layer: for detailed information about the layer composition see annex Table 5. None of the layer had a response rate of lower than 45%.

The different language part of Switzerland showed a similar response rate: German-speaking companies answered in the layered survey by 58% (700/1202), French-speaking by 57% (188/328) and Italian-speaking by 63% (60/96).

However, the response rate of the companies depended on the size of the companies. Figure 5 shows a response rate of 54% for micro, 64% for small, 74% for middle and 73% for big companies (sent questionnaires per size-group = 100%). As the smallest companies (which are in numbers the most frequent) showed the least response rate, this may influence the interpretation of the comparison of the answering and non-answering group, which is presented in chapter 3.1.4 "Results of quality test: comparability of answering and non-answering".

In percentage the positive responses to the questionnaire did slightly depend on the size of the companies. Compared to the sent questionnaires, we received the most positive answers (in the sense of "yes, we use, produce or free nanoparticles") by the largest companies, and the least answers by the smallest ones. But positive answers were not very frequent.

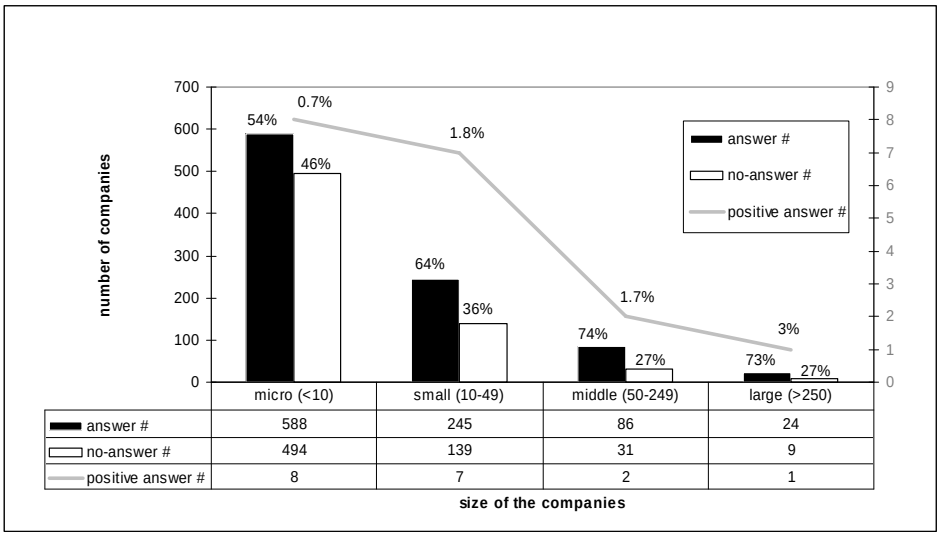


Figure 5: Number of companies giving an answer to the survey and number of positive answers. The positive answer curve (in the sense of "yes, we handle nanoparticles" has its own scale on the right site. The curve of positive answers (n=18, where 2 are in the same company at different production sites) follows roughly the number of answers but seems in % of the sent questionnaires slightly to depend on the size of the companies.

3.1.3. Results of quality test: data entry

The data entry was done twice for every questionnaire: the negative responses (only one filled page) were entered once by hand typing and once by electronic questionnaire reading. Because there was some additional information on the backside of some completely filled out questionnaires (positives responses), we decided to verify these hand typed data by a second hand typing.

a) Comparison of hand typing and electronic reading: we compared two methods of questionnaire digitalising, concerning 21508 fields on 1132 questionnaires (only the first page with general information about the company). The error level was low: 909 compared pages were identically. On 119 pages we detected 158 different data, where the error was a bad electronic reading (e.g. crosses only close to a field, but not inside, or cancelled crosses). This represents 0.73% of electronic reading errors. On 26 pages we detected 53 different data, where the error was a bad hand typing. This represents 0.25% human errors. The estimated potential error of a wrong data even with the double data entry is therefore (0.73% * 0.25% = 0.0018%). The expected number of wrong fields for the data set is less than a half (21508 fields * 0.0018% errors = 0.4 expected wrong fields).

b) Comparison of the two hand typing of the filled three-pages questionnaires: we compared the double typing of 63 questionnaires with 6237 fields (without the hand written parts). On 41 pages we detected 94 differences (74 times was the first typing correct, 67 times the second typing). This represents an error of 1.1% in the first case and an error of 1.2% in the second. The expected wrong fields for the data set is therefore less than one (6237 fields * 0.013% errors = 0.8 expected wrong fields).

3.1.4. Results of quality test: comparability of answering and non-answering

The similarity of the two groups (answering and not answering) was tested by a Wilcoxon test. We chose the company size as an element describing the companies: The test showed that there is a difference between the responding and non-responding group: In the non-responding group were more very small companies. This fact has to be considered in the final extrapolation to the whole Swiss workforce, once the quality tests are finished.

3.2. Results of questionnaire

3.2.1. Nanoparticles usage: layer specific answers

The positive results of the layered survey ("yes we produce/use or liberate nanoparticles ") were found in ten different layers, but the most cases we registered in the chemical industry. Figure 6 shows the responses from companies that may use or produce particles <100nm: however one chemical company and one surface treatment company reported particles as <1000nm without further specification.

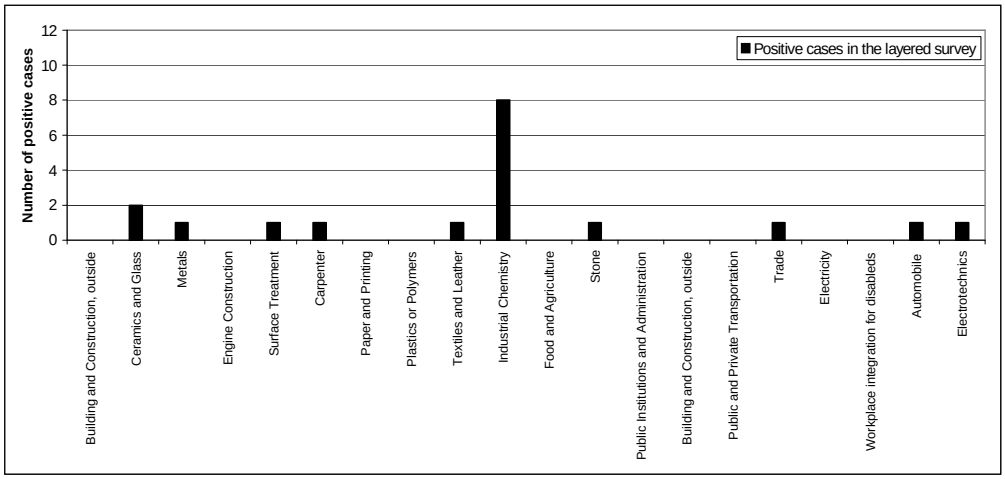


Figure 6: Positive responses from the different layers - only layered survey, statistically representative but slightly biased. Of the 18 cases only 8 reported well-defined average sizes of their particles, 10 did not provide any information about the size of their particles.

The ten origins in Figure 6 above are discovered by the representative survey. Knowing that that the statistical sampling was eventually biased due to the layering, we completed the survey by the two additional not-statistical surveys. The additional surveys show two more layers with nanoparticle applications: the building layer and the paper/print layer (Figure 7). Ten of the companies in Figure 7 reported particles with an average size between 100nm and 1200nm, often without a size distribution. Clarifications concerning this matter are still going on.

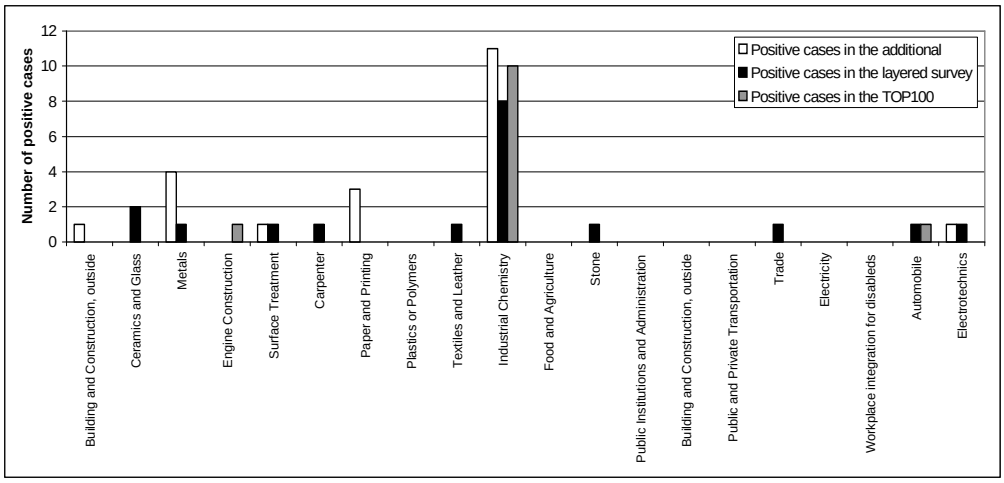


Figure 7: Number of companies stating that they use nanoparticles. The results of the tree surveys are not very different, but a few companies were found in the additional survey and one in the Top100, which was not registered in the layered survey. Of the 44 cases only 23 reported well-defined average sizes of the particles, 21 did not provide any information about the size of their particles.

3.2.2. Function of the answering person

The answers of the layered survey were classified into five groups of persons filling out the questionnaire: The questionnaires were mostly filled out by the management level of the companies: of the 831 questionnaires reporting the responding person's position 5.8% stated to be filled out by the safety representative, 22.1% by someone working for administration, 66.5% by a member of the management, 2.8% by a member of the human resources and 2.8% by a basic worker.

3.2.3. Number of positive answers

The layered survey shows that only 18 companies (one company counted double) use nanoparticles. This corresponds to about 1.9% of the interviewed companies. The layered survey did not discover any producer of nanoparticles.

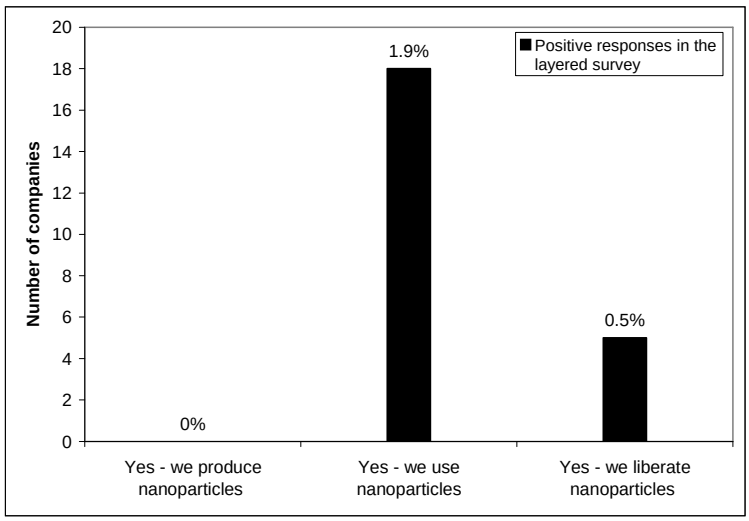


Figure 8: The question about the producing, using or liberating of nanoparticles was answered 18 times (where 2 in the same company). The four companies answering that they liberated nanoparticles did report both usage and liberating.

3.2.4. Type of nanoparticles

The nanoparticles reported in the questionnaire were grouped into organic (all nanoparticles containing carbon), metallic (all nanoparticles of pure metal), inorganic (all metal oxides) and the non-defined nanoparticles. Table 1 shows that organic and inorganic nanoparticles are more used than metallic ones.

Table 1: Type of nanoparticles reported by the companies. Several companies reported more than one type of used nanoparticles.

Type of nanoparticles	Number of companies in the layered survey	Number of applications in the layered survey	Number of companies in all three surveys	Number of applications in all three surveys
Organic	7	7	20	27
Metallic	1	1	3	5
Inorganic	7	12	18	41
Undefined	6	6	12	13

Organic particles were in the layered survey reported to be used in an total amount of 2201 kg/year (2 companies did not provide data), the inorganic particles of 10482 kg/year, the metallic of 0.1 kg/year and the undefined of 1500 kg/year (4 companies did not provide data).

3.2.5. Stock of nanoparticles

The amount of nanoparticles stocked in the companies of the layered survey was mostly at a level of less than a ton.

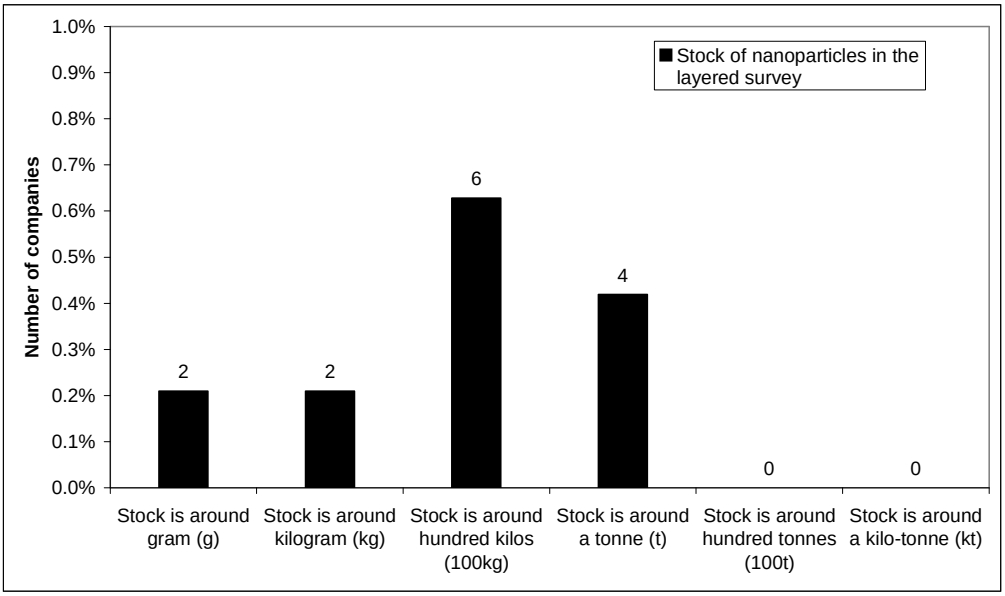


Figure 9: Percentage/number of the companies in the layered survey and the indicated stock of nanoparticles.

Figure 10 shows the amount of nanoparticles stocked in the companies of all three surveys together: it reached from some grams to some kilotons and did not show a typical stock size. Stocks of more than a ton was shown to exist, but not in the layered survey.

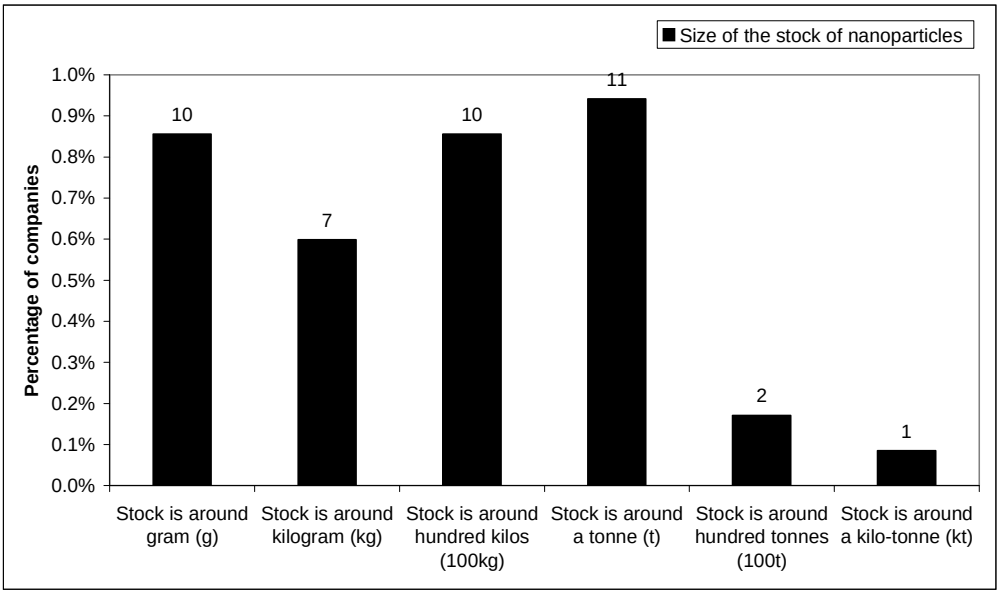


Figure 10: Combined size of the stock of nanoparticles: layered survey, the Top100 survey and additional sector's survey.

3.2.6. Extrapolation of the results to all SUVA clients

Each layer was sampled separately according to the calculated sample size. The reported usage of nanoparticles has been extrapolated to all companies of the same layer considering that some layers have been over sampled (<50 --> 50) and considering that some addresses did not exist (lost cases). Table 2 shows that the most reporting layer (industrial chemistry) is an over sampled sector, and has therefore a lower importance in the extrapolation. It shows furthermore that the expected number of companies among the sampled SUVA clients (n=78736) would be 350, which corresponds to 0.4% them.

	Nh (size of layer)	Size of the sample per layer (based on 1.6870137% per layer)	nh (theoretical size of survey numbers <50 --> 50)	nh (real: some addresses did not exist)	% difference to the statistic plan	Real % of the layer, receiving a letter	Correction factor to adjust the difference to the 1.6870137% per layer)	Number of companies reporting to use nanoparticles	Layer size of Clients	Estimated number of occurrence in the sample (with correction factor)	% positive in Layer (incl. real correction factor)	Extrapolation Expected cases among the SUVA-Clients
Building and Construction, outside	16301	275	275	265	100%	1.63%	1.0377	0	16301	0.00	0.0%	0
Ceramics and Glass	334	6	50	49	887%	14.67%	0.1150	2	334	0.23	0.5%	2
Metals	3862	65	65	62	100%	1.61%	1.0508	1	3862	1.05	1.7%	65
Engine Construction	4481	76	75	72	99%	1.61%	1.0499	0	4481	0.00	0.0%	0
Surface Treatment	366	6	50	43	810%	11.75%	0.1436	1	366	0.14	0.3%	1
Carpenter	5670	96	95	95	99%	1.68%	1.0069	1	5670	1.01	1.1%	60
Paper and Printing	1441	24	50	49	206%	3.40%	0.4961	0	1441	0.00	0.0%	0
Plastics or Polymers	778	13	50	48	381%	6.17%	0.2734	0	778	0.00	0.0%	0
Textiles and Leather	1172	20	50	49	253%	4.18%	0.4035	1	1172	0.40	0.8%	10
Industrial Chemistry	633	11	50	45	468%	7.11%	0.2373	8	633	1.90	4.2%	27
Food and Agriculture	447	8	50	48	663%	10.74%	0.1571	0	447	0.00	0.0%	0
Stone	248	4	50	50	1195%	20.16%	0.0837	1	248	0.08	0.2%	0
Public Institutions and Administr.	2985	50	50	50	99%	1.68%	1.0071	0	2985	0.00	0.0%	0
Building and Construction, outside	10364	175	175	167	100%	1.61%	1.0470	0	10364	0.00	0.0%	0
Public and Private Transportation	5666	96	95	93	99%	1.64%	1.0278	0	5666	0.00	0.0%	0
Trade	3506	59	59	58	100%	1.65%	1.0198	1	3506	1.02	1.8%	62
Electricity	3394	57	57	55	100%	1.62%	1.0410	0	3394	0.00	0.0%	0
Workplace integration for disableds	281	5	50	49	1055%	17.44%	0.0967	0	281	0.00	0.0%	0
Automobile	11283	190	190	186	100%	1.65%	1.0234	1	11283	1.02	0.6%	62
Electrotechnics	5524	93	93	92	100%	1.67%	1.0129	1	5524	1.01	1.1%	61
Sum	78736	1328	1679	1626				18				350

Table 2: Extrapolation of the reported nanoparticle usage to all SUVA clients. A reported usage of nanoparticles was multiplied with a correction factor, considering the number of sent questionnaires in the concerning layer. This allows calculating an expected percentage of cases in the layer.

4. Discussion

The presented layered survey was built to be representative for all SUVA-clients, which is a good representation of all Swiss companies in the productive sectors. The sampling of companies was not focussed on "high-tech" companies in the field of nanotechnology but the most different types of industrial economic sectors as possible, only excluding a few administrative economic sectors.

The rate of non-respondents to respondents was not significantly different with regard to language areas in Switzerland, but there was a slight under representation of responses from the smallest companies. However, this difference does not seem to considerably affect the overall result of the survey.

The survey shows that nanoparticles are used in less than one percent of the Swiss industry. This study is the first quantitative study, based on a representative sample, showing such a percentage, representative for a country.

This survey shows similar amounts of used nanoparticles in the Swiss industry as our qualitative survey (see "Intermediate report: a qualitative pilot study" 26.05.2006): the scale reaches form only some grams to some hundreds of tons, but mostly below some hundred kilos per year. The shown size of the stock of nanoparticles can be interesting for risk analysis. Most of the companies used a relatively small stock of nanoparticles. Only in the two additional targeted surveys we found stocks bigger than some tons.

The used particle types show a difference in their number of applications and the amount of used particles. The most used particles in weight and numbers of applications are inorganic, the least metallic.

A limitation of the here presented results is that the quality assurance efforts are not yet fully completed (quality test by phone call not yet done). Also, a more thorough analysis and interpretation of the here presented results will be needed to gain a better understanding of its implications for occupational settings. However, the results already provide valuable insight about the usage of nanoparticles in Swiss industry.

5. References

1. Chaudhry, M. Q., Boxall, A. B., Aitken, R. J., and Hull, M. Scoping Study into the Manufacture and Use of Nanomaterials in the UK, (CB01070). http://www2.defra.gov.uk/research/project_data/More.asp?I=CB01070&M=CFO&V= CSL . 2005. Sand Hutton, York: Central Science Laboratory.

2. Hoet, P. H., Bruske-Hohlfeld, I., and Salata, O. V., 2004, Nanoparticles - known and unknown health risks: J.Nanobiotechnology., v. 2, p. 12.

3. Meili C., Widmer M., Husmann F., Gehr P., Blank F., Riediker M., Schmid K., Stark W., Limbach L. 2007: Synthetische Nanomaterialien. Risikobeurteilung und Risikomanagement. Grundlagenbericht zum Aktionsplan. Umwelt-Wissen Nr. 0721. Bundesamt für Umwelt und Bundesamt für Gesundheit, Bern. 284 S.

6. Annex

6.1. Details to the methodology

6.1.1. Excluded sectors from Top100

Table 3: Some economic sectors have been excluded from the Top100 survey to focus on the industrial part. The numbers in front of the description is the SUVA-Code of the economic sector.

SUVA	Description
25P	Impression and medias
40M	Public administration
42B	Forestry
46H	Train restaurants and night trains
47B	Train companies
47D	Tramways and Trolleybus companies
47E	Ski lift companies
48A	Aviation companies
49A	Transport companies
50A	Plane maintaining companies
52A	Depots and department stores
55A	Power plants and electricity distributing companies
55C	Electricity transport mean montage - air and soil
55D	Electricity installation companies
56B	Gas distribution companies
60F	Office economic and technique, services administrative
61A	Governmental administration, post offices
70C	Employee placement
99B	Program for temporary occupation of non employed

6.1.2. Pre-advised associations

Table 4: List of association receiving an informative letter before the survey

Definition	Webpage	Acronym
Chemie	www.sgci.ch	SSIC (SGCI)
Verband der Schweizer Druckindustrie	www.vsd.ch	IGS (VSD)
Verband Schweizerischer Lack und Farbenfabrikanten	www.vslf.ch	USVP (VSLF)
Kosmetik / Waschmittel	www.skw-cds.ch	ASCD (SKW)
Papier	www.zpk.ch	ASPI (ZPK)
Plastik	www.kvs.ch	ASMP (KVS)
Tierfutter	www.vsf-mills.ch	VSF
Lebensmittel	www.sglwt.ch	SOSSTA (SGLWT)
Mikroelektronik	www.swico.ch	SWICO
Sensoren	www.sensors.ch	ASTC (SVS)
Uhren	www.fhs.ch	FHS
Baumaterial	www.vsbh.ch	ASMMC (VSBH)
Textilien	www.swisstextiles.ch	FTS (TVS)
Spitäler	www.hplus.ch	H+
Maschinen-, Elektro- und Metallindustrie	www.swissmem.ch	Swissmem
Arbeitssicherheit	www.sgas.ch	SGAS
Ergonomie	www.swissergo.ch	Swissergo
Studiengruppe für Gesundheitsschutz in Industrie, Dienstleistung und Gewerbe	www.sgig.ch	SGIG
Groupement Romand de Médecine, d'Hygiène et de Sécurité au Travail	www.grmhst.ch	GRMHST
Grenzwert Kommission	-	GWK
Dachverband Sicherheit und Gesundheitsschutz am Arbeitsplatz	www.suissepro.org	SWISSPRO
Schweizerische Organisation der Wirtschaft für Umweltschutz Arbeitssicherheit und Gesundheitsschutz	www.eco-swiss.ch	ECOSWISS
Arbeitnehmerschutz	www.iva-ch.ch	AIPT (IVA)
Société des hygiénistes du travail	www.sgah.ch	SSHT (SGAH)

6.1.3.Pre advising letter

Fondation universitaire romande de Santé au Travail
Institut universitaire romand de Santé au Travail
Institute for Occupational Health Sciences

Verbandkürzel PräsidentIn
Vorname, Name
Name des Verbandes
Strassenbezeichnung
PLZ Ort

Lausanne, den 20. September 2006

Nanoinventar

Sehr geehrte(r) Herr/Frau .....

in den nächsten Tagen beginnt eine repräsentative Erhebung über die Verbreitung von Nanopartikeln in der Schweizer Industrie. Diese Studie erfolgt im Auftrag von SUVA, BAG, BAFU und SECO und hat zum Ziel, die Grössenordnung und die Art des heutigen Einsatzes von Nanopartikel in der Schweizer Industrie zu dokumentieren. Sie wird vom Institut de Santé au Travail in Lausanne durchgeführt.

Die SUVA wird dazu den Sicherheitsverantwortlichen von rund 2000 Unternehmen aus allen produzierenden Branchen einen Fragebogen zustellen mit der Bitte, ihn auszufüllen und zur Auswertung ans Institut de Santé au Travail zu senden. Die Fragen betreffen Partikeltypen, Mengen, und den Umgang mit den Partikeln. Die Fragen sind bewusst so formuliert, dass keine Produktionsgeheimnisse preisgegeben werden müssen.

Diese Daten werden helfen, geeignete Arbeitsschutzmassnahmen zu evaluieren und Forschungsschwerpunkte zu setzen. Wir können damit das Wissen erarbeiten, wie die Arbeitnehmer vor den eventuellen Gesundheitsrisiken von Nanopartikeln geschützt werden können. Dieses Wissen kann danach der Erarbeitung von Broschüren zur konkreten Empfehlung von Schutzmassnahmen dienen.

Damit wir den Bedarf Ihres Verbandes bei dieser Erhebung korrekt erheben, wären wir ihnen dankbar, wenn Sie Ihre Mitglieder zum vollständigen Ausfüllen des Fragebogens ermutigen würden. Beiliegend finden Sie einen Entwurf des Fragebogens. Für allfällige Fragen stehen wir Ihnen gerne zur Verfügung!

Mit freundlichen Grüssen,

Dr. Michael Riediker Kaspar Schmid

Beilage: erwähnt

Geht an Präsidenten von:
ASM/VSM/Swissmem, ASMMC (VSBH), FHS, GRMST, GWK, H+, KVS, SCASS, SGCI, VSD, SGIG, SGLWT, SKW, SVS/ASTC/SSST, SWICO, Swissergo, TVS, VSBH, VSBH, VSF, VSLF, ZPK

IST, rue du Bugnon 19, CH-1005 Lausanne (Suisse/Switzerland)
Tél. +41-(0)21-314 74 21 / Fax +41-(0)21-314 74 20
http://www.iurst.ch

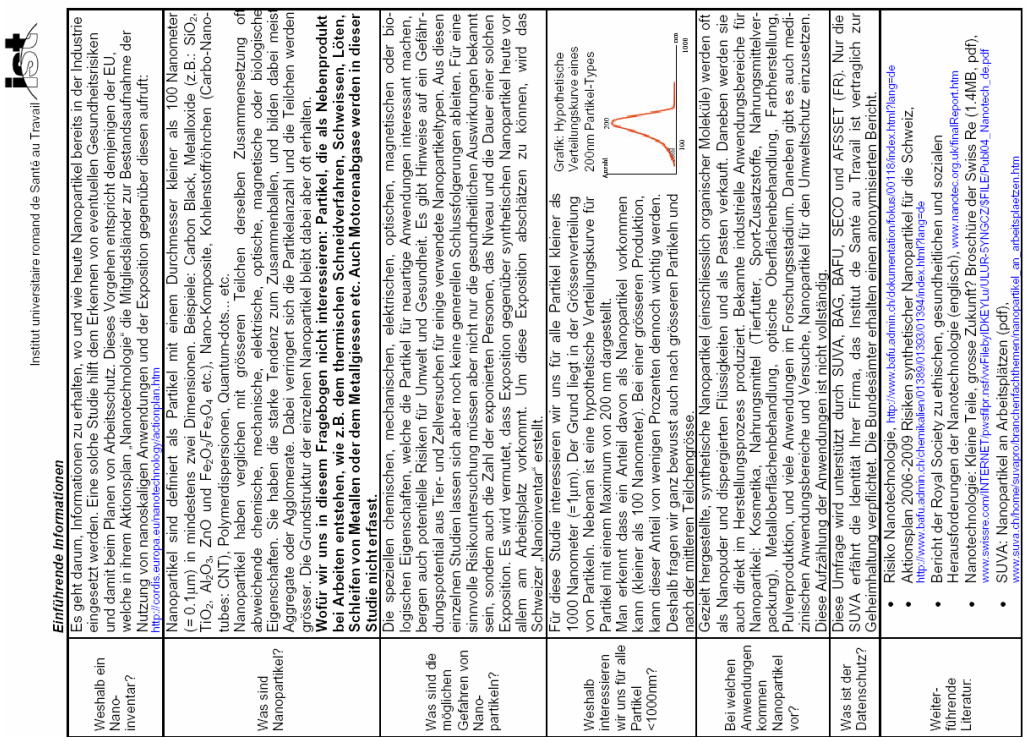
Figure 11: Informative letter, sent to a selection of industrial associations. The letter was sent together with the description of the study and the provisional questionnaire.

6.1.4.Description of layers

Table 5: Description of the economic sectors in the statistical layers

Short definition	*SUVA-Code*	*Description in German*
Construction site and related sectors (inside)	01A	Zement-, Kalk- u. Gipsfabriken - Abbau
	01B	Sand- und Kieswerke, Transportbetonwerke, Mischgutbetriebe
	02A	Zementwarenfabriken
	44D	Malen und Gipsen
	45B	Bodenlegergeschäfte
	45BA	Bodenlegergeschäfte
	45BB	Bodenlegergeschäfte mit Innendekoration, Näherei
	45D	Gebäudereinigungsgeschäfte, Gebäudeunterhalt
	45G	Installationsgeschäfte fü Sanitär-/Heizungs-/Klima-Lüftungsanlagen; Bau-Spenglereien
	45GC	Kaminfegergeschäfte
	45GD	Tankrevisionsbetriebe
	45GE	Installationsgeschäfte
	45GF	Bauspenglereien
	45GG	Installationsbetriebe, Bauspenglereien
	45GH	Bauspengler. m. Dachdecker
	45GK	Installationsbetriebe, Bauspenglerei m. Dachdecker
	45L	Montagebetriebe
	45M	Wand- und Bodenplattenlegergeschäfte, Hafnergeschäfte; Betr., die Kälte-, Wärme-, Schallisolationen ausführen oder Deckenverkleidungen montieren
Ceramic and glass	06A	Keramik und Glas
	06AA	Grobkeramik
	06AB	Feinkeramik
	06AC	Glas und Glasprodukte
	06AD	Glasverarbeitung / Glaserei
Metal sector	10M	Metallurgie
	10MA	Erzeugen von Metallen
	10MB	Massifumformen von Metallen
	10MC	Giessen v. Metallen in Nicht-Sandformen
	10MD	Giessen von Metallen in Sandformen
	11C	Stahl-/Metall-/Apparatebau; allg. Schlossereien, Schmieden
	11CA	Stahl- u. Metallbau, allg. Schlossereien, Schmieden
	16B	Herst. von Eisen-, Blech und Metallwaren
	16BA	Industriespenglereien
	16BB	Metallwaren-/Blechemballagenfabriken, Stanzereien
	16BC	Herstellung von Drahtprodukten
	16BD	Schliesstechnik, Schneidwaren und Waffengeschäfte
Engine construction	11CB	Apparatebau, Konstruktionsschlossereien
	11CC	Herstellung, Montage u. Reparatur von Rollläden und Storen
	11CD	Herstellung von Stahlrohrmöbeln u. leichten Metallrohrerzeugnissen
	13B	Maschinen-/Anlagebau
	13BA	Herstellung v. Bestandteilen für die Maschinenbau-Branche
	13BB	Maschinen-/Anlagebau
	13BC	Montage und Reparatur von Produkten der Maschinenbau-Branche
Surface	16C	Oberflächentechnik
	16CA	Betr. der Lackiertechnik
	16CB	Betr. der Galvanotechnik
	16CC	Betr. der thermischen Oberflächentechnik
Carpenter	17S	Sägereien und Holzindustrie (ohne Zimmereien)
	18S	Schreinereien
Paper and Print sector	22D	Fabr. von Papier, Karton, Pappe, Halbstoffe
	25C	Papier-, Folien- u. Kartonverarbeitung, Wellkartonfabrikation
	25CA	Papier-/Folienverarbeitung
	25CB	Kartonfabriken
	25P	Grafisches Gewerbe, Fotolabors, Filmstudios, Kinos, Filmverleih
	25PG4F	Filmstudio, Tonstudio
	25PG4K	Kino, Verleih von Bild- und Tonträgern
	25PG4L	Fotolabor
	25PG4P	Herstellung von Planungs-, Ordnungs-, Repräsentationsmitteln
	25PG4S	Schriften- und Reklamegestaltung
	25PG4V	Druckvorstufe, Druckformherstellung
	25PG4W	Druckweiterverarbeitung, Buchbinderei
	25PGO	Druckerei
Plastic	23C	Betriebe, die Artikel aus Kunststoff herstellen und verarbeiten
	23CA	Masch. Verarbeitung v. Kunststoff zu Profilen/Bahnen, Kunststoffaufbereitung
	23CB	Masch. Verarbeitung von Kunststoff zu Formstücken
	23CC	Handwerkliche Verarbeitung v. Kunststoff; spanende und spanlose Weiterverarbeitung. v. Kunststoff-Halbfabrikaten

Short definition	*SUVA-Code*	*Description in German*
Textile and clothing	26A	Betriebe, die Leder erzeugen und verarbeiten, Innendekorationsgeschäfte
	26AA	Innendekorationen
	26AB	Schuhfabriken, Betriebe der Ledererzeugung, Fellzurichtereien u. Pelzveredlungsbetriebe
	27T	Textil- und Bekleidungsindustrie
	27TA	Spinnstoffaufbereitung, Garne, textile Gewebe herstellen
	27TB	Garne, textile Gewebe herstellen (ohne Spinnstoffaufbereitung)
	27TC	Bekleidungsindustrie
	27TD	Chemiefasern herstellen
	30B	Nasswäschereien, chem. Reinigungsanstalten
Chemistry	32A	Herstellung von Grund- und Feinchemikalien, pharmazeutische und kosmetische Produkte
	32F	Herstellung chemischtechnischer Produkte
Food	35H	Schlachthofbetriebe
	35I	Metzgereien, Fleischwarenfabriken; Betriebe, die Schlachthausnebenprodukte verwerten
	35N	Betriebe der Nahrungsmittelindustrie
	37D	Zigaretten- und Zigarrenfabrikation
Stone	38S	Steinbildhauerwerkstätten, Steinsägewerke
Governmental	40M	Öffentliche Verwaltungen
	40MA	Eigenbedarfsarbeiten
	40MC	Spitäler, Heime
	40MD	Administrative Verwaltungen, Schulen
Construction site and related sectors (outside)	41A	Betriebe die Arbeiten des Bauhauptgewerbes (Erd-, Maurer-, Beton-, Steinhauer- u. Zimmereiarbeiten) ausführen, Felsmaterial gewinnen od. Bauelemente aus Beton herstellen
	42B	Forstbetriebe
	44E	Bedachungen, Fassadenbekleidungen
Transport	46A	Bundesbahnen
	46H	Speise- u. Schlafwagengesellschaften, Restaurationsbetriebe
	47B	Konzessionierte Eisenbahnen
	47D	Strassenbahnen, Trolleybusbetriebe verbunden mi Autobuslinien
	47E	Luftseilbahnen / Skilifte
	48A	Schifffahrtsbetriebe
	49A	Strassentransportbetriebe
	50A	Luftfahrtsbetriebe, Luftfahrzeugunterhaltsbetriebe
Trade	52A	Handels- und Lagerbetriebe
	52AG	Allgemeiner Handel
	52AH	Stahl-, Metallhalbzeughandel
	52AK	Baumaterial-, Holzwerkstoffhandel
	52AL	Brenn-, Treibstoffhandel
	52AM	Landwirtschaftliche Genossenschaften
	52AN	Lagerhäuser
	52AR	Spezielle Grossverteiler (Migros)
	52D	Altstoffhandel, Recyclingbetriebe
	52T	Getränkeherstellung, Geränkehandel
	52TA	Getränkeherstellung
	52TB	Brauereien
	52TC	Getränkehandel, Getränkedepots
Electricity	55A	Kraftwerke, Stromverteilungsbetriebe
	55C	Frei- u. Kabelleitungsbau
	55D	Elektroinstallationsgeschäfte
	56B	Gasversorgungsbetriebe, verbunden mit Elektrizitätsversorgung
Administration	60F	Kaufm. u. techn. Büros, Verwaltungen, Reisedienste, Verkaufsläden
	60FC	Büros, Verkaufsläden, Reisedienste
	60FD	Technische Büros
	61A	Allgemeine Bundesverwaltungen, Postbetriebe
	70C	Verleih von Personal
	70CA	Ausleihe Betriebspersonal
	70CB	Ausleihe Büropersonal
	99B	Programme für die vorübergehende Beschäftigung von Arbeitslosen
Workshops for disableds	71A	Invalidenwerkstätten
Vehicle related companies	13D	Reparaturwerkstätten für Strassenfahrzeuge, Landwirtschafts- und Baumaschinen
	13DA	Reparaturwerkstätten für leichte Motorwagen, Service-Stationen
	13DB	Reparaturwerkstätten für schwere Motorwagen
	13DC	Reparaturwerkstätten für Landwirtschafts- und Baumaschinen
	13DD	Reparaturwerkstätten für Fahr-, Motorfahr- und Motorräder
	13E	Karosseriewerke, Autospenglereien u. Lackierwerke, Waggonfabriken, Bootsbaubetriebe, Flugzeugwerke
	13EA	Karosseriewerke
	13ED	Autospenglereien und Lackierwerke Mitbeteiligung Autospenglereien und Bootsbaubetriebe
Electrotechnic	15D	Elektro-, Informations-, Medizinal- und Zahntechnik, Uhren und Schmuck



Institut universitaire romand de Santé au Travail

Einführende Informationen

Weshalb ein Nano-inventar?	Es geht darum, Informationen zu erhalten, wo und wie heute Nanopartikel bereits in der Industrie eingesetzt werden. Eine solche Studie hilft dem Erkennen von eventuellen Gesundheitsrisiken und damit beim Planen von Arbeitsschutz. Dieses Vorgehen entspricht demjenigen der EU, welche in ihrem Aktionsplan „Nanotechnologie" die Mitgliedsländer zur Bestandsaufnahme der Nutzung von nanoskaligen Anwendungen und der Exposition gegenüber diesen aufruft: http://cordis.europa.eu/nanotechnology/actionplan.htm
Was sind Nanopartikel?	Nanopartikel sind definiert als Partikel mit einem Durchmesser kleiner als 100 Nanometer (= 0.1µm) in mindestens zwei Dimensionen. Beispiele: Carbon Black, Metalloxide (z.B.: SiO_2, TiO_2, Al_2O_3, ZnO und Fe_2O_3/Fe_3O_4 etc.), Nano-Komposite, Kohlenstoffröhrchen (Carbo-Nano-tubes: CNT), Polymerdispersionen, Quantum-dots... etc. Nanopartikel haben verglichen mit grösseren Teilchen derselben Zusammensetzung oft abweichende chemische, mechanische, elektrische, optische, magnetische oder biologische Eigenschaften. Sie haben die starke Tendenz zum Zusammenballen, und bilden dabei meist Aggregate oder Agglomerate. Dabei verringert sich die Partikelanzahl und die Teilchen werden grösser. Die Grundstruktur der einzelnen Nanopartikel bleibt dabei aber oft erhalten. **Wofür wir uns in diesem Fragebogen nicht interessieren: Partikel, die als Nebenprodukt bei Arbeiten entstehen, wie z.B. dem thermischen Schneidverfahren, Schweissen, Löten, Schleifen von Metallen oder dem Metallgiessen etc. Auch Motorenabgase werden in dieser Studie nicht erfasst.**
Was sind die möglichen Gefahren von Nano-partikeln?	Die speziellen chemischen, mechanischen, elektrischen, optischen, magnetischen oder biologischen Eigenschaften, welche die Partikel für neuartige Anwendungen interessant machen, bergen auch potentielle Risiken für Umwelt und Gesundheit. Es gibt Hinweise auf ein Gefährdungspotential aus Tier- und Zellversuchen für einige verwendete Nanopartikeltypen. Aus diesen einzelnen Studien lassen sich aber noch keine generellen Schlussfolgerungen ableiten. Für eine sinnvolle Risikountersuchung müssen aber nicht nur die gesundheitlichen Auswirkungen bekannt sein, sondern auch die Zahl der exponierten Personen, das Niveau und die Dauer einer solchen Exposition. Es wird vermutet, dass Exposition gegenüber synthetischen Nanopartikel heute vor allem am Arbeitsplatz vorkommt. Um diese Exposition abschätzen zu können, wird das Schweizer „Nanoinventar" erstellt.
Weshalb interessieren wir uns für alle Partikel <1000nm?	Für diese Studie interessieren wir uns für alle Partikel kleiner als 1000 Nanometer (=1µm). Der Grund liegt in der Grössenverteilung von Partikeln. Nebenan ist eine hypothetische Verteilungskurve für Partikel mit einem Maximum von 200 nm dargestellt. Man erkennt dass ein Anteil davon als Nanopartikel vorkommen kann (kleiner als 100 Nanometer). Bei einer grösseren Produktion, kann dieser Anteil von wenigen Prozenten dennoch wichtig werden. Deshalb fragen wir ganz bewusst auch nach grösseren Partikeln und nach der mittleren Teilchengrösse.
Bei welchen Anwendungen kommen Nanopartikel vor?	Gezielt hergestellte, synthetische Nanopartikel (einschliesslich organischer Moleküle) werden oft als Nanopuder und dispergierten Flüssigkeiten und als Pasten verkauft. Daneben werden sie auch direkt im Herstellungsprozess produziert. Bekannte industrielle Anwendungsbereiche für Nanopartikel: Kosmetika, Nahrungsmittel (Tierfutter, Sport-Zusatzstoffe, Nahrungsmittelverpackung), Metalloberflächenbehandlung, optische Oberflächenbehandlung, Farbherstellung, Pulverproduktion, und viele Anwendungen im Forschungsstadium. Daneben gibt es auch medizinischen Anwendungsbereiche und Versuche. Nanopartikel für den Umweltschutz einzusetzen. Diese Aufzählung der Anwendungen ist nicht vollständig.
Was ist der Datenschutz?	Diese Umfrage wird unterstützt durch SUVA, BAG, BAFU, SECO und AFSSET (FR). Nur die SUVA erfährt die Identität Ihrer Firma, das Institut de Santé au Travail ist vertraglich zur Geheimhaltung verpflichtet. Die Bundesämter erhalten einen anonymisierten Bericht.
Weiter-führende Literatur:	• Risiko Nanotechnologie, http://www.bafu.admin.ch/dokumentation/focus/00118/index.html?lang=de • Aktionsplan 2006-2009 Risiken synthetischer Nanopartikel für die Schweiz, http://www.bafu.admin.ch/chemikalien/01398/01399/index.html?lang=de • Bericht der Royal Society zu ethischen, gesundheitlichen und sozialen Herausforderungen der Nanotechnologie (englisch), www.nanotec.org.uk/finalReport.htm • Nanotechnologie: Kleine Teile, grosse Zukunft? Broschüre der Swiss Re (1.4MB, pdf), www.swissre.com/INTERNET/pwsfilpr.nsf/vwFileByIDKEYLu/UUUR-5YNGCZ/$FILE/Publ04_Nanotech_de.pdf • SUVA: Nanopartikel an Arbeitsplätzen (pdf), www.suva.ch/home/suvapro/branchenfachthemen/nanopartikel_an_arbeitsplaetzen.htm

Grafik: Hypothetische Verteilungskurve eines 200nm Partikel-Types

Figure 12: Introduction for the companies to the Nanoinventory and the goal of the survey.

Institut universitaire romand de santé au travail

Erhebung zur Verbreitung von Nanopartikel in der Schweizer Industrie

NANO-INVENTAR
18.12.2007

Diese Erhebung erfolgt mit Unterstützung durch SUVA, BAG, BAFU, SECO und AFSSET (FR)
Sämtliche Angaben unterliegen der Geheimhaltung
Die Identität Ihres Unternehmens wird einzig gegenüber der SUVA offengelegt

Das „Institut universitaire romand de Santé au Travail" (IST):
Das Institut für Arbeit und Gesundheit, ist das einzige universitäre Institut der Schweiz, welches sich ganz dem Thema Gesundheit und Arbeit widmet. Es wird primär durch Stiftungsbeiträge der Kantone Waadt und Genf getragen und hat als Auftrag die Lehre, Forschung, Dienstleistung und Förderung des Gebietes „Arbeit und Gesundheit". Es ist dazu national und international tätig.
Das Institut de Santé au Travail hat keinerlei Kontrollaufgaben und tritt nur beratend und als Experte auf.
Das Institut befindet sich in Lausanne und verfügt über etwa sechzig Mitarbeiter (Mediziner, Ergonomen, Psychologen, Chemiker, Geologen, Biologen, Ingenieure, Techniker, Laboranten, Sekretäre, Lehrlinge), die national und international in ihrer Disziplin anerkannt sind. Das IST ist zudem ein Kollaborationszentrum der Weltgesundheitsorganisation WHO für den Bereich Arbeit und Gesundheit.

Zuständig für Rückfragen am Institut de Santé au Travail:
Kaspar Schmid (DE/FR/E)
Tel. +41 (0)21 314 74 15, FAX: +41 (0)21 314 74 30
Mail: nanoinventory@hospvd.ch

Projektleitung: Michael Riediker, Dr.sc.nat., IST
Auftraggeber und Projektfinanzierungen: SUVA, BAG, BAFU, SECO und AFSSET (FR)

Rücksendeadresse:
Institut de Santé au Travail
Vermerk: Nanoinventar
Rue du Bugnon 19
1005 Lausanne

Figure 13: Cover letter to survey, German

XXX-XXXX.X

Institut universitaire romand de santé au travail

NANO-INVENTAR FRAGEBOGEN: Grunddaten des Unternehmens

Diese Erhebung erfolgt mit Unterstützung durch SUVA, BAG, BAFU, SECO und AFSSET (FR). **Sämtliche Angaben unterliegen der Geheimhaltung. Die Identität des Unternehmens wird einzig gegenüber der SUVA offengelegt.**

Ihr Unternehmen (Institution/Organisation) wurde per Zufall aus sämtlichen SUVA-Klienten ausgewählt. Bitte retournieren Sie den Fragebogen auch wenn Sie kein Produktionsbetrieb sind oder keine Produktion in der Schweiz haben: füllen Sie dazu diese erste Seite aus und nutzen Sie die Fragen 7. und 8. um dies klar zu machen.

Diese Spalte leer lassen

Grunddaten des Unternehmens

1. Firmenname:	1.	1.
2. Adresse (Hauptsitz):	2.	2.
3. Kontaktperson:	3.	3.
4. Ungefähre Anzahl Mitarbeiter:	4.	4.
5. SUVA-Nummer:	5. SUVA:	5.
6. Was ist Ihre Branche?	6.	6.
7. Haben Sie eine Produktion?	7. a) ☐ Ja b) ☐ Nein c) wenn ja, wo? Postleitzahl:	7.a 7.b
8. Bemerkungen zu den Grunddaten des Unternehmens?	8.	8.

Definition: Nanopartikel sind definitionsgemäss kleiner als 100 Nanometer (=0.1µm). Für diese Studie interessieren wir uns aber für sämtliche Partikel kleiner als 1000 Nanometer (=1µm), siehe Erklärungs-Blatt. **Im Folgenden werden wir daher nach „Submikrometerpartikel" (Partikel <1µm) oder sub/µm Partikel fragen**.

Werden bei Ihnen synthetische Submikrometerpartikel hergestellt oder verwendet?

9. Werden bei Ihnen sub/µm Partikel		9.1a 9.1b
9.1. hergestellt?	9.1 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht	9.1c
9.2. verwendet?	9.2 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht	9.2a 9.2b
9.3. durch Bearbeitung von Produkten freigesetzt? (nicht gemeint sind Dieselpartikel oder Schweissrauche etc. siehe Informationsblatt)	9.3 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht	9.2c 9.3a 9.3b
9.4. in Zukunft geplant	9.4 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht	9.3c 9.4a 9.4b 9.4c

Falls Sie keine sub/µm Partikel verwenden oder herstellen geben Sie uns bitte an, warum Sie dies NICHT tun:

☐ kein Anwendungsbedarf ☐ gesundheitliche Bedenken ☐ weiss nicht
☐ technische Gründe ☐ zu teuer ☐ anders, nämlich:

Hinweis: Falls Sie die **Fragen 9.1 bis 9.3 mit „nein"** angekreuzt haben und **keine** sub/µm Partikel verwenden oder produzieren, können Sie den Fragebogen hier abschliessen und an das *institut de santé au travail* zurückschicken.

Ich bestätige, dass diese Erhebung nach bestem Wissen und Gewissen ausgefüllt wurde.

Ausgefüllt von (Name): Funktion: Unterschrift:

Bitte bis Ende Februar 2007 zurücksenden

Figure 14: General questions to the companies, German. All pages were personalised with the SUVA number of the company (XXX-XXXX.XX).

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Institut universitaire romand de santé au travail

Grunddaten des Unternehmens MIT sub/µm Partikeln

Diese Spalte leer lassen

10. Welches sind die hierarchischen Stufen, die sich mit Sicherheitsfragen zu sub/µm Partikeln beschäftigen?	10. a)☐ Linien-/Produktionsleiter b)☐ Direktion c)☐ Sicherheitsbeauftragter/Hygieniker d)☐ anders, nämlich:	10.a 10.b 10.c 10.d
11. Ist das Unternehmen einer Branchenlösung angeschlossen? Nummer oder Träger angeben.	11. a) EKAS-Nr: b)☐ nein, keine Branchenlösung oder Träger: (z.B. Nr. 7, Träger: Textilverband Schweiz)	11.a 11.b
12. Gibt es einen Arbeitsmediziner oder Arbeitshygieniker in Ihrer Firma?	12.1 Arbeitsmediziner a)☐ Ja b)☐ Nein c)☐ extern 12.2 Arbeitshygieniker a)☐ Ja b)☐ Nein c)☐ extern 12.3 Sicherheitsingenieur a)☐ Ja b)☐ Nein c)☐ extern 12.4 Sicherheitsbeauftragter a)☐ Ja b)☐ Nein c)☐ extern	12.1a 12.1b 12.1c 12.2a 12.2b 12.2c 12.3a 12.3b 12.3c 12.4a 12.4b 12.4c
13. Wie häufig werden Angestellte über mögliche Gefahren von sub/µm Partikeln informiert?	13. a)☐ bei jedem Auftrag b)☐ ca. 1x pro Woche c)☐ ca. 1x pro Monat d)☐ ca. 1x pro Jahr e)☐ anders, nämlich: f)☐ nie	13.a 13.b 13.c 13.d 13.e 13.f
14. Enthält die technische Beschreibung Ihrer Produkte einen Hinweis auf sub/µm Partikel?	14. a)☐ Ja b)☐ Nein c) wenn ja, welchen?	14.a 14.b 14.c
15. Welche sub/µm Partikel verwenden Sie? Bitte geben Sie alle verfügbaren Informationen an. Beispiele für Prozess: „Lackherstellung“ oder „Lackierung“ und für Endprodukt: „Lackfarbe“ oder „Möbeloberfläche“. Bitte verwenden Sie die Rückseite oder ein Zusatzblatt, wenn Ihre Firma mehr als drei Partikeltypen verwendet.	15. a)Produktname 1: b)Partikel-Substanz: c)Prozessbezeichnung: d)Endprodukt: e)mittlere Partikelgrösse: f) Partikelname 2: g)Partikel-Substanz: h)Prozessbezeichnung: i) Endprodukt: j) mittlere Partikelgrösse: k)Partikelname 3: l) Partikel-Substanz: m)Prozessbezeichnung: n)Endprodukt: o)mittlere Partikelgrösse:	15.a 15.b 15.c 15.d 15.e 15.f 15.g 15.h 15.i 15.j 15.k 15.l 15.m 15.n 15.o
16. Frage zur Lagerung: 16.1. Welche ungefähren Mengen sub/µm-Partikel sind bei Ihnen Durchschnittlich an Lager? 16.2. In welcher ungefähren Menge erfolgt eine Zulieferung zu Ihnen? (Ihr Einkauf) 16.3. Wie oft werden sie zugeliefert? 16.4. In welcher ungefähren Menge erfolgt eine Ablieferung an den Kunden? (Ihr Verkauf) 16.5. Wie oft werden sie abgeliefert?	Falls Sie mehrere sub/µm Partikeltypen haben, beantworten Sie diese Fragen bitte für jeden Partikeltyp einzeln (Rückseite oder Zusatzblatt)... 16.1 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ anders nämlich: 16.2 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ anders nämlich: 16.3 a)☐ pro Woche b)☐ pro Monat c)☐ pro Jahr d)☐ anders nämlich: 16.4 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ anders nämlich: 16.4 a)☐ pro Woche b)☐ pro Monat c)☐ pro Jahr d)☐ anders nämlich:	16.1a 16.1b 16.1c 16.1d 16.1e 16.1f 16.1g 16.2a 16.2b 16.2c 16.2d 16.2e 16.2f 16.2g 16.3a 16.3b 16.3c 16.3d 16.4a 16.4b 16.4c 16.4d 16.4e 16.4f 16.4g 16.5a 16.5b 16.5c 16.5d

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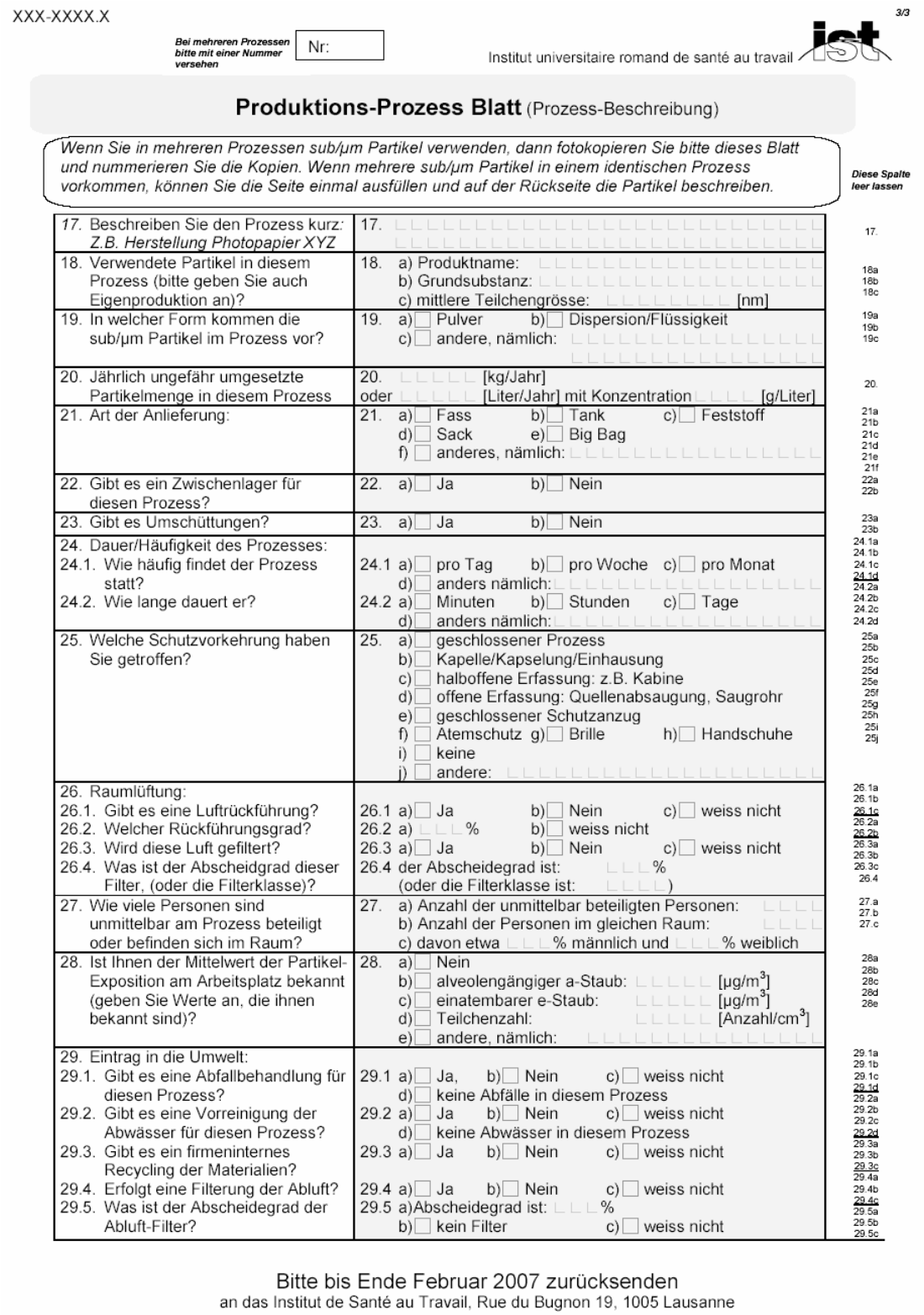
Figure 15: Questions about the types and amounts of used nanoparticles, German. All pages were personalised with the SUVA number of the company (XXX-XXXX.XX).



XXX-XXXX.X

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Bei mehreren Prozessen bitte mit einer Nummer versehen

Nr:

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Produktions-Prozess Blatt (Prozess-Beschreibung)

Wenn Sie in mehreren Prozessen sub/µm Partikel verwenden, dann fotokopieren Sie bitte dieses Blatt und nummerieren Sie die Kopien. Wenn mehrere sub/µm Partikel in einem identischen Prozess vorkommen, können Sie die Seite einmal ausfüllen und auf der Rückseite die Partikel beschreiben.

Diese Spalte leer lassen

17. Beschreiben Sie den Prozess kurz: *Z.B. Herstellung Photopapier XYZ*	17.	17.
18. Verwendete Partikel in diesem Prozess (bitte geben Sie auch Eigenproduktion an)?	18. a) Produktname: b) Grundsubstanz: c) mittlere Teilchengrösse: [nm]	18a 18b 18c
19. In welcher Form kommen die sub/µm Partikel im Prozess vor?	19. a) ☐ Pulver b) ☐ Dispersion/Flüssigkeit c) ☐ andere, nämlich:	19a 19b 19c
20. Jährlich ungefähr umgesetzte Partikelmenge in diesem Prozess	20. [kg/Jahr] oder [Liter/Jahr] mit Konzentration [g/Liter]	20.
21. Art der Anlieferung:	21. a) ☐ Fass b) ☐ Tank c) ☐ Feststoff d) ☐ Sack e) ☐ Big Bag f) ☐ anderes, nämlich:	21a 21b 21c 21d 21e 21f
22. Gibt es ein Zwischenlager für diesen Prozess?	22. a) ☐ Ja b) ☐ Nein	22a 22b
23. Gibt es Umschüttungen?	23. a) ☐ Ja b) ☐ Nein	23a 23b
24. Dauer/Häufigkeit des Prozesses: 24.1. Wie häufig findet der Prozess statt? 24.2. Wie lange dauert er?	24.1 a) ☐ pro Tag b) ☐ pro Woche c) ☐ pro Monat d) ☐ anders nämlich: 24.2 a) ☐ Minuten b) ☐ Stunden c) ☐ Tage d) ☐ anders nämlich:	24.1a 24.1b 24.1c 24.1d 24.2a 24.2b 24.2c 24.2d
25. Welche Schutzvorkehrung haben Sie getroffen?	25. a) ☐ geschlossener Prozess b) ☐ Kapelle/Kapselung/Einhausung c) ☐ halboffene Erfassung: z.B. Kabine d) ☐ offene Erfassung: Quellenabsaugung, Saugrohr e) ☐ geschlossener Schutzanzug f) ☐ Atemschutz g) ☐ Brille h) ☐ Handschuhe i) ☐ keine j) ☐ andere:	25a 25b 25c 25d 25e 25f 25g 25h 25i 25j
26. Raumlüftung: 26.1. Gibt es eine Luftrückführung? 26.2. Welcher Rückführungsgrad? 26.3. Wird diese Luft gefiltert? 26.4. Was ist der Abscheidgrad dieser Filter, (oder die Filterklasse)?	26.1 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht 26.2 a) % b) ☐ weiss nicht 26.3 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht 26.4 der Abscheidegrad ist: % (oder die Filterklasse ist:)	26.1a 26.1b 26.1c 26.2a 26.2b 26.3a 26.3b 26.3c 26.4
27. Wie viele Personen sind unmittelbar am Prozess beteiligt oder befinden sich im Raum?	27. a) Anzahl der unmittelbar beteiligten Personen: b) Anzahl der Personen im gleichen Raum: c) davon etwa % männlich und % weiblich	27.a 27.b 27.c
28. Ist Ihnen der Mittelwert der Partikel-Exposition am Arbeitsplatz bekannt (geben Sie Werte an, die ihnen bekannt sind)?	28. a) ☐ Nein b) ☐ alveolengängiger a-Staub: [µg/m³] c) ☐ einatembarer e-Staub: [µg/m³] d) ☐ Teilchenzahl: [Anzahl/cm³] e) ☐ andere, nämlich:	28a 28b 28c 28d 28e
29. Eintrag in die Umwelt: 29.1. Gibt es eine Abfallbehandlung für diesen Prozess? 29.2. Gibt es eine Vorreinigung der Abwässer für diesen Prozess? 29.3. Gibt es ein firmeninternes Recycling der Materialien? 29.4. Erfolgt eine Filterung der Abluft? 29.5. Was ist der Abscheidegrad der Abluft-Filter?	29.1 a) ☐ Ja, b) ☐ Nein c) ☐ weiss nicht d) ☐ keine Abfälle in diesem Prozess 29.2 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht d) ☐ keine Abwässer in diesem Prozess 29.3 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht 29.4 a) ☐ Ja b) ☐ Nein c) ☐ weiss nicht 29.5 a) Abscheidegrad ist: % b) ☐ kein Filter c) ☐ weiss nicht	29.1a 29.1b 29.1c 29.1d 29.2a 29.2b 29.2c 29.2d 29.3a 29.3b 29.3c 29.4a 29.4b 29.4c 29.5a 29.5b 29.5c

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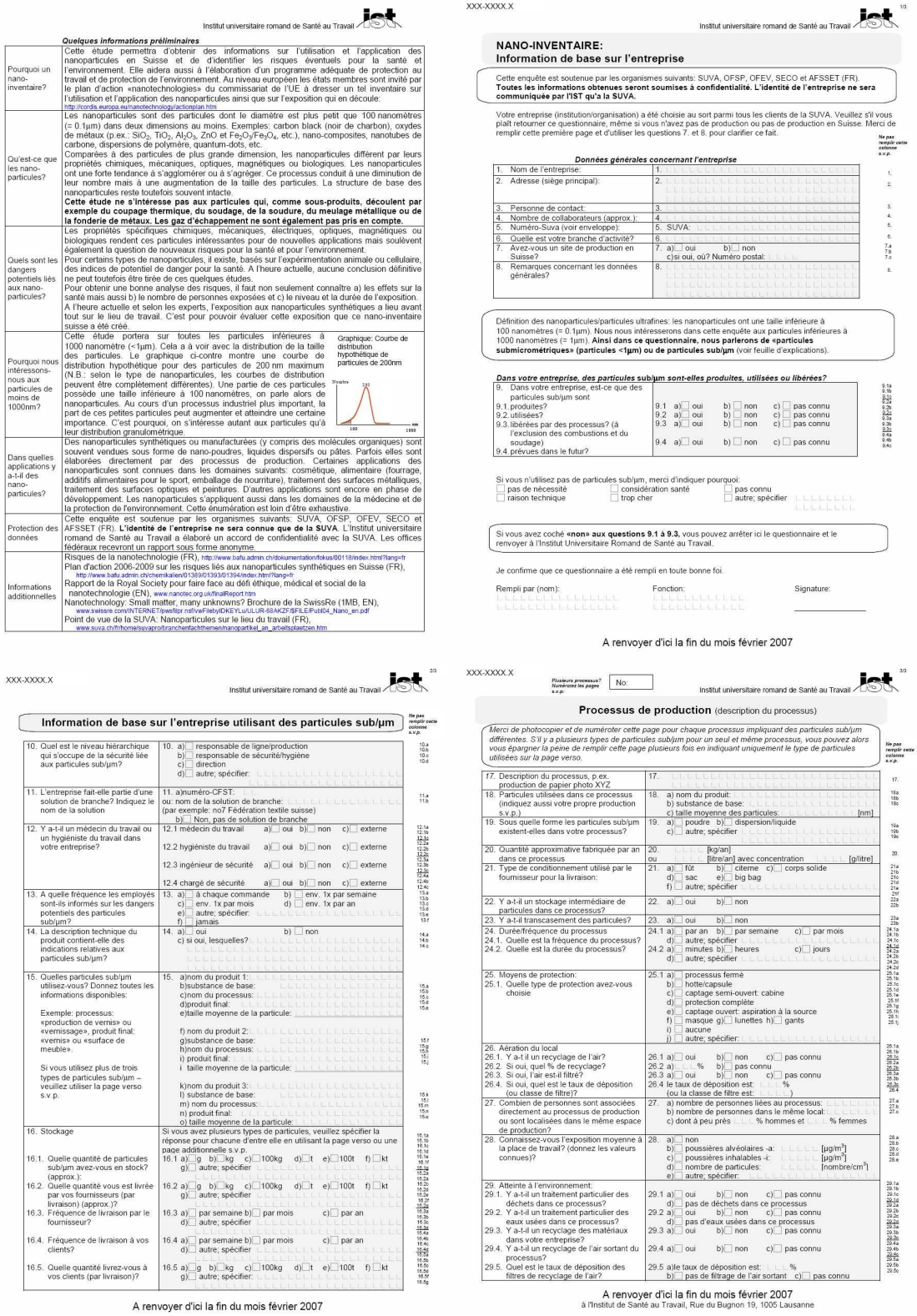
an das Institut de Santé au Travail, Rue du Bugnon 19, 1005 Lausanne

Figure 16: Specific questions about the application and the used protection means, German. All pages were personalised with the SUVA number of the company (XXX-XXXX.XX).



Institut universitaire romand de Santé au Travail

Quelques informations préliminaires

Pourquoi un nano-inventaire?	Cette étude permettra d'obtenir des informations sur l'utilisation et l'application des nanoparticules en Suisse et de d'identifier les risques éventuels pour la santé et l'environnement. Elle aidera aussi à l'élaboration d'un programme adéquate de protection au travail et de protection de l'environnement. Au niveau européen les états membres sont invité par le plan d'action «nanotechnologies» du commissariat de l'UE à dresser un tel inventaire sur l'utilisation et l'application des nanoparticules ainsi que sur l'exposition qui en découle: http://cordis.europa.eu/nanotechnology/actionplan.htm
Qu'est-ce que les nano-particules?	Les nanoparticules sont des particules dont le diamètre est plus petit que 100 nanomètres (= 0.1µm) dans deux dimensions au moins. Exemples: carbon black (noir de charbon), oxydes de métaux (p.ex.: SiO_2, TiO_2, Al_2O_3, ZnO et Fe_2O_3/Fe_3O_4, etc.), nano-composites, nanotubes de carbone, dispersions de polymère, quantum-dots, etc. Comparées à des particules de plus grande dimension, les nanoparticules diffèrent par leurs propriétés chimiques, mécaniques, optiques, magnétiques ou biologiques. Les nanoparticules ont une forte tendance à s'agglomérer ou à s'agréger. Ce processus conduit à une diminution de leur nombre mais à une augmentation de la taille des particules. La structure de base des nanoparticules reste toutefois souvent intacte. **Cette étude ne s'intéresse pas aux particules qui, comme sous-produits, découlent par exemple du coupage thermique, du soudage, de la soudure, du meulage métallique ou de la fonderie de métaux. Les gaz d'échappement ne sont également pas pris en compte.**
Quels sont les dangers potentiels liés aux nano-particules?	Les propriétés spécifiques chimiques, mécaniques, électriques, optiques, magnétiques ou biologiques rendent ces particules intéressantes pour de nouvelles applications mais soulèvent également la question de nouveaux risques pour la santé et pour l'environnement. Pour certains types de nanoparticules, il existe, basés sur l'expérimentation animale ou cellulaire, des indices de potentiel de danger pour la santé. A l'heure actuelle, aucune conclusion définitive ne peut toutefois être tirée de ces quelques études. Pour obtenir une bonne analyse des risques, il faut non seulement connaître a) les effets sur la santé mais aussi b) le nombre de personnes exposées et c) le niveau et la durée de l'exposition. A l'heure actuelle et selon les experts, l'exposition aux nanoparticules synthétiques a lieu avant tout sur le lieu de travail. C'est pour pouvoir évaluer cette exposition que ce nano-inventaire suisse a été créé.
Pourquoi nous intéressons-nous aux particules de moins de 1000nm?	Cette étude portera sur toutes les particules inférieures à 1000 nanomètre (<1µm). Cela a à voir avec la distribution de la taille des particules. Le graphique ci-contre montre une courbe de distribution hypothétique pour des particules de 200 nm maximum (N.B.: selon le type de nanoparticules, les courbes de distribution peuvent être complètement différentes). Une partie de ces particules possède une taille inférieure à 100 nanomètres, on parle alors de nanoparticules. Au cours d'un processus industriel plus important, la part de ces petites particules peut augmenter et atteindre une certaine importance. C'est pourquoi, on s'intéresse autant aux particules qu'à leur distribution granulométrique. Graphique: Courbe de distribution hypothétique de particules de 200nm
Dans quelles applications y a-t-il des nano-particules?	Des nanoparticules synthétiques ou manufacturées (y compris des molécules organiques) sont souvent vendues sous forme de nano-poudres, liquides dispersifs ou pâtes. Parfois elles sont élaborées directement par des processus de production. Certaines applications des nanoparticules sont connues dans les domaines suivants: cosmétique, alimentaire (fourrage, additifs alimentaires pour le sport, emballage de nourriture), traitement des surfaces métalliques, traitement des surfaces optiques et peintures. D'autres applications sont encore en phase de développement. Les nanoparticules s'appliquent aussi dans les domaines de la médecine et de la protection de l'environnement. Cette énumération est loin d'être exhaustive.
Protection des données	Cette enquête est soutenue par les organismes suivants: SUVA, OFSP, OFEV, SECO et AFSSET (FR). **L'identité de l'entreprise ne sera connue que de la SUVA.** L'Institut universitaire romand de Santé au Travail a élaboré un accord de confidentialité avec la SUVA. Les offices fédéraux recevront un rapport sous forme anonyme.
Informations additionnelles	Risques de la nanotechnologie (FR), http://www.batu.admin.ch/dokumentation/fokus/00118/index.html?lang=fr Plan d'action 2006-2009 sur les risques liés aux nanoparticules synthétiques en Suisse (FR), http://www.batu.admin.ch/chemikalien/01389/01393/01394/index.html?lang=fr Rapport de la Royal Society pour faire face au défi éthique, médical et social de la nanotechnologie (EN), www.nanotec.org.uk/finalReport.htm Nanotechnology: Small matter, many unknowns? Brochure de la SwissRe (1MB, EN), www.swissre.com/INTERNET/pwelfpr.nsf/vwFilebyIDKEY/LuUL-LR-68AKZF-$FILE/Publ04_Nano_en.pdf Point de vue de la SUVA: Nanoparticules sur le lieu du travail (FR), www.suva.ch/fr/home/suvapro/branchenfachthemen/nanopartikel_an_arbeitsplaetzen.htm

A renvoyer d'ici la fin du mois février 2007

XXX-XXXX.X

Institut universitaire romand de Santé au Travail

NANO-INVENTAIRE: Information de base sur l'entreprise

Cette enquête est soutenue par les organismes suivants: SUVA, OFSP, OFEV, SECO et AFSSET (FR). **Toutes les informations obtenues seront soumises à confidentialité. L'identité de l'entreprise ne sera communiquée par l'IST qu'a la SUVA.**

Votre entreprise (institution/organisation) a été choisie au sort parmi tous les clients de la SUVA. Veuillez s'il vous plaît retourner ce questionnaire, même si vous n'avez pas de production ou pas de production en Suisse. Merci de remplir cette première page et d'utiliser les questions 7. et 8. pour clarifier ce fait.

Données générales concernant l'entreprise

1. Nom de l'entreprise:	1.
2. Adresse (siège principal):	2.
3. Personne de contact:	3.
4. Nombre de collaborateurs (approx.):	4.
5. Numéro-Suva (voir enveloppe):	5. SUVA:
6. Quelle est votre branche d'activité?	6.
7. Avez-vous un site de production en Suisse?	7. a) ☐ oui b) ☐ non c) si oui, où? Numéro postal:
8. Remarques concernant les données générales?	8.

Définition des nanoparticules/particules ultrafines: les nanoparticules ont une taille inférieure à 100 nanomètres (= 0.1µm). Nous nous intéresserons dans cette enquête aux particules inférieures à 1000 nanomètres (= 1µm). **Ainsi dans ce questionnaire, nous parlerons de «particules submicrométriques» (particules <1µm) ou de particules sub/µm** (voir feuille d'explications).

Dans votre entreprise, des particules sub/µm sont-elles produites, utilisées ou libérées?

9. Dans votre entreprise, est-ce que des particules sub/µm sont	
9.1 produites?	9.1 a) ☐ oui b) ☐ non c) ☐ pas connu
9.2 utilisées?	9.2 a) ☐ oui b) ☐ non c) ☐ pas connu
9.3 libérées par des processus? (à l'exclusion des combustions et du soudage)	9.3 a) ☐ oui b) ☐ non c) ☐ pas connu
9.4 prévues dans le futur?	9.4 a) ☐ oui b) ☐ non c) ☐ pas connu

Si vous n'utilisez pas de particules sub/µm, merci d'indiquer pourquoi:
☐ pas de nécessité ☐ considération santé ☐ pas connu
☐ raison technique ☐ trop cher ☐ autre; spécifier

Si vous avez coché **«non» aux questions 9.1 à 9.3,** vous pouvez arrêter ici le questionnaire et le renvoyer à l'Institut Universitaire Romand de Santé au Travail.

Je confirme que ce questionnaire a été rempli en toute bonne foi.

Rempli par (nom): Fonction: Signature:

A renvoyer d'ici la fin du mois février 2007

XXX-XXXX.X

Institut universitaire romand de Santé au Travail

Information de base sur l'entreprise utilisant des particules sub/µm

10. Quel est le niveau hiérarchique qui s'occupe de la sécurité liée aux particules sub/µm?	10. a) ☐ responsable de ligne/production b) ☐ responsable de sécurité/hygiène c) ☐ direction d) ☐ autre; spécifier:
11. L'entreprise fait-elle partie d'une solution de branche? Indiquez le nom de la solution	11. a) numéro-OFST: ou: nom de la solution de branche: (par exemple: no7 Fédération textile suisse) b) ☐ Non, pas de solution de branche
12. Y a-t-il un médecin du travail ou un hygiéniste du travail dans votre entreprise?	12.1 médecin du travail a) ☐ oui b) ☐ non c) ☐ externe 12.2 hygiéniste du travail a) ☐ oui b) ☐ non c) ☐ externe 12.3 ingénieur de sécurité a) ☐ oui b) ☐ non c) ☐ externe 12.4 chargé de sécurité a) ☐ oui b) ☐ non c) ☐ externe
13. A quelle fréquence les employés sont-ils informés sur les dangers potentiels des particules sub/µm?	13. a) ☐ à chaque commande b) ☐ env. 1x par semaine c) ☐ env. 1x par mois d) ☐ env. 1x par an e) ☐ autre; spécifier: f) ☐ jamais
14. La description technique du produit contient-elle des indications relatives aux particules sub/µm?	14. a) ☐ oui b) ☐ non c) si oui, lesquelles?
15. Quelles particules sub/µm utilisez-vous? Donnez toutes les informations disponibles: Exemple: processus: «production de vernis» ou «vernissage», produit final: «vernis» ou «surface de meuble». Si vous utilisez plus de trois types de particules sub/µm – veuillez utiliser la page verso s.v.p.	15. a) nom du produit 1: b) substance de base: c) nom du processus: d) produit final: e) taille moyenne de la particule: f) nom du produit 2: g) substance de base: h) nom du processus: i) produit final: i taille moyenne de la particule: k) nom du produit 3: l) substance de base: m) nom du processus: n) produit final: o) taille moyenne de la particule:
16. Stockage 16.1. Quelle quantité de particules sub/µm avez-vous en stock? (approx.): 16.2. Quelle quantité vous est livrée par vos fournisseurs (par livraison) (approx.)? 16.3. Fréquence de livraison par le fournisseur? 16.4. Fréquence de livraison à vos clients? 16.5. Quelle quantité livrez-vous à vos clients (par livraison)?	Si vous avez plusieurs types de particules, veuillez spécifier la réponse pour chacune d'entre elle en utilisant la page verso ou une page additionnelle s.v.p. 16.1 a) ☐ g b) ☐ kg c) ☐ 100kg d) ☐ t e) ☐ 100t f) ☐ kt g) ☐ autre; spécifier 16.2 a) ☐ g b) ☐ kg c) ☐ 100kg d) ☐ t e) ☐ 100t f) ☐ kt g) ☐ autre; spécifier 16.3 a) ☐ par semaine b) ☐ par mois c) ☐ par an d) ☐ autre; spécifier 16.4 a) ☐ par semaine b) ☐ par mois c) ☐ par an d) ☐ autre; spécifier 16.5 a) ☐ g b) ☐ kg c) ☐ 100kg d) ☐ t e) ☐ 100t f) ☐ kt g) ☐ autre; spécifier:

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Plusieurs processus? Numérotez les pages s.v.p. No:

Processus de production (description du processus)

Merci de photocopier et de numéroter cette page pour chaque processus impliquant des particules sub/µm différentes. S'il y a plusieurs types de particules sub/µm pour un seul et même processus, vous pouvez alors vous épargner la peine de remplir cette page plusieurs fois en indiquant uniquement le type de particules utilisées sur la page verso.

17. Description du processus, p.ex. production de papier photo XYZ	17.
18. Particules utilisées dans ce processus (indiquez aussi votre propre production s.v.p.)	18. a) nom du produit: b) substance de base: c) taille moyenne des particules: [nm]
19. Sous quelle forme les particules sub/µm existent-elles dans votre processus?	19. a) ☐ poudre b) ☐ dispersion/liquide c) ☐ autre; spécifier
20. Quantité approximative fabriquée par an dans ce processus	20. [kg/an] ou [litre/an] avec concentration [g/litre]
21. Type de conditionnement utilisé par le fournisseur pour la livraison:	21. a) ☐ fût b) ☐ citerne c) ☐ corps solide d) ☐ sac e) ☐ big bag f) ☐ autre; spécifier
22. Y a-t-il un stockage intermédiaire de particules dans ce processus?	22. a) ☐ oui b) ☐ non
23. Y a-t-il transcasement des particules?	23. a) ☐ oui b) ☐ non
24. Durée/fréquence du processus 24.1. Quelle est la fréquence du processus? 24.2. Quelle est la durée du processus?	24.1 a) ☐ par an b) ☐ par semaine c) ☐ par mois d) ☐ autre; spécifier 24.2 a) ☐ minutes b) ☐ heures c) ☐ jours d) ☐ autre; spécifier
25. Moyens de protection: 25.1. Quelle type de protection avez-vous choisie	25.1 a) ☐ processus fermé b) ☐ hotte/capsule c) ☐ captage semi-ouvert: cabine d) ☐ protection complète e) ☐ captage ouvert: aspiration à la source f) ☐ masque g) ☐ lunettes h) ☐ gants i) ☐ aucune j) ☐ autre; spécifier:
26. Aération du local 26.1. Y a-t-il un recyclage de l'air? 26.2. Si oui, quel % de recyclage? 26.3. Si oui, l'air est-il filtré? 26.4. Si oui, quel est le taux de déposition (ou classe de filtre)?	26.1 a) ☐ oui b) ☐ non c) ☐ pas connu 26.2 a) ☐ % b) ☐ pas connu 26.3 a) ☐ oui b) ☐ non c) ☐ pas connu 26.4 le taux de déposition est: % (ou la classe de filtre est:)
27. Combien de personnes sont associées directement au processus de production ou sont localisées dans le même espace de production?	27. a) nombre de personnes liées au processus: b) nombre de personnes dans le même local: c) dont à peu près % hommes et % femmes
28. Connaissez-vous l'exposition moyenne à la place de travail? (donnez les valeurs connues)?	28. a) ☐ non b) ☐ poussières alvéolaires -a: [µg/m³] c) ☐ poussières inhalables -i: [µg/m³] d) ☐ nombre de particules: [nombre/cm³] e) ☐ autre; spécifier:
29. Atteinte à l'environnement: 29.1. Y a-t-il un traitement particulier des déchets dans ce processus? 29.2. Y a-t-il un traitement particulier des eaux usées dans ce processus? 29.3. Y a-t-il un recyclage des matériaux dans votre entreprise? 29.4. Y a-t-il un recyclage de l'air sortant du processus? 29.5. Quel est le taux de déposition des filtres de recyclage de l'air?	29.1 a) ☐ oui b) ☐ non c) ☐ pas connu d) ☐ pas de déchets dans ce processus 29.2 a) ☐ oui b) ☐ non c) ☐ pas connu d) ☐ pas d'eaux usées dans ce processus 29.3 a) ☐ oui b) ☐ non c) ☐ pas connu 29.4 a) ☐ oui b) ☐ non c) ☐ pas connu 29.5 a) le taux de déposition est: % b) ☐ pas de filtrage de l'air sortant c) ☐ pas connu

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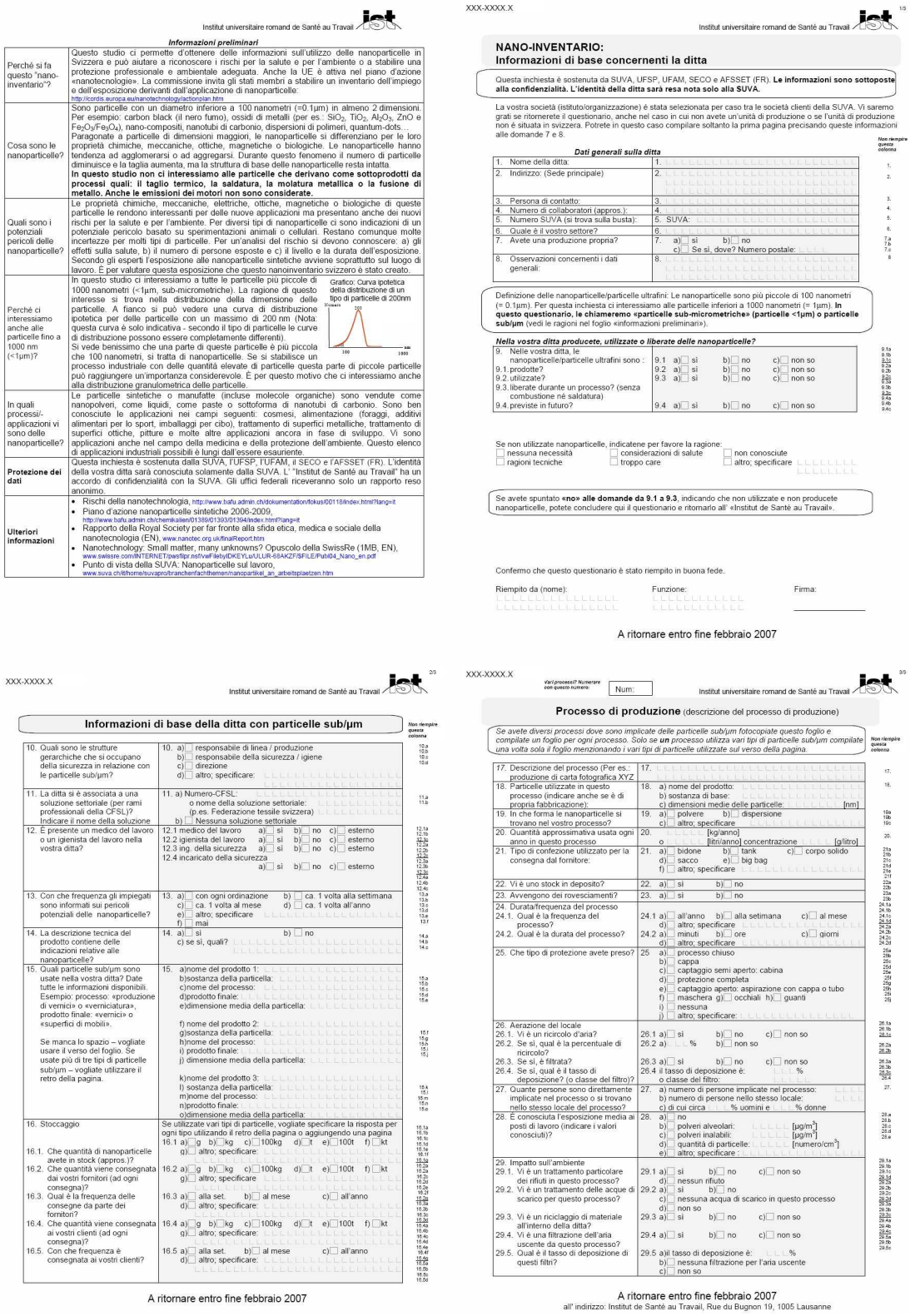
Figure 17: Questionnaire in French



Institut universitaire romand de Santé au Travail

Informazioni preliminari

Perché si fa questo "nano-inventario"?	Questo studio ci permette d'ottenere delle informazioni sull'utilizzo delle nanoparticelle in Svizzera e può aiutare a riconoscere i rischi per la salute e per l'ambiente o a stabilire una protezione professionale e ambientale adeguata. Anche la UE è attiva nel piano d'azione «nanotecnologie». La commissione invita gli stati membri a stabilire un inventario dell'impiego e dell'esposizione derivanti dall'applicazione di nanoparticelle. http://cordis.europa.eu/nanotechnology/actionplan.htm
Cosa sono le nanoparticelle?	Sono particelle con un diametro inferiore a 100 nanometri (=0.1µm) in almeno 2 dimensioni. Per esempio: carbon black (il nero fumo), ossidi di metalli (per es.: SiO_2, TiO_2, Al_2O_3, ZnO e Fe_2O_3/Fe_3O_4), nano-compositi, nanotubi di carbonio, dispersioni di polimeri, quantum-dots… Paragonate a particelle di dimensioni maggiori, le nanoparticelle si differenziano per le loro proprietà chimiche, meccaniche, ottiche, magnetiche o biologiche. Le nanoparticelle hanno tendenza ad agglomerarsi o ad aggregarsi. Durante questo fenomeno il numero di particelle diminuisce e la taglia aumenta, ma la struttura di base delle nanoparticelle resta intatta. **In questo studio non ci interessiamo alle particelle che derivano come sottoprodotti da processi quali: il taglio termico, la saldatura, la molatura metallica o la fusione di metallo. Anche le emissioni dei motori non sono considerate.**
Quali sono i potenziali pericoli delle nanoparticelle?	Le proprietà chimiche, meccaniche, elettriche, ottiche, magnetiche o biologiche di queste particelle le rendono interessanti per delle nuove applicazioni ma presentano anche dei nuovi rischi per la salute e per l'ambiente. Per diversi tipi di nanoparticelle ci sono indicazioni di un potenziale pericolo basato su sperimentazioni animali o cellulari. Restano comunque molte incertezze per molti tipi di particelle. Per un'analisi del rischio si devono conoscere: a) gli effetti sulla salute, b) il numero di persone esposte e c) il livello e la durata dell'esposizione. Secondo gli esperti l'esposizione alle nanoparticelle sintetiche avviene soprattutto sul luogo di lavoro. È per valutare questa esposizione che questo nanoinventario svizzero è stato creato.
Perché ci interessiamo anche alle particelle fino a 1000 nm (<1µm)?	In questo studio ci interessiamo a tutte le particelle più piccole di 1000 nanometri (<1µm, sub-micrometriche). La ragione di questo interesse si trova nella distribuzione della dimensione delle particelle. A fianco si può vedere una curva di distribuzione ipotetica per delle particelle con un massimo di 200 nm (Nota: questa curva è solo indicativa - secondo il tipo di particelle le curve di distribuzione possono essere completamente differenti). Si vede benissimo che una parte di queste particelle è più piccola che 100 nanometri, si tratta di nanoparticelle. Se si stabilisce un processo industriale con delle quantità elevate di particelle questa parte di piccole particelle può raggiungere un'importanza considerevole. È per questo motivo che ci interessiamo anche alla distribuzione granulometrica delle particelle. Grafico: Curva ipotetica della distribuzione di un tipo di particelle di 200nm
In quali processi/-applicazioni vi sono delle nanoparticelle?	Le particelle sintetiche o manufatte (incluse molecole organiche) sono vendute come nanopolveri, come liquidi, come paste o sottoforma di nanotubi di carbonio. Sono ben conosciute le applicazioni nei campi seguenti: cosmesi, alimentazione (foraggi, additivi alimentari per lo sport, imballaggi per cibo), trattamento di superfici metalliche, trattamento di superfici ottiche, pitture e molte altre applicazioni ancora in fase di sviluppo. Vi sono applicazioni anche nel campo della medicina e della protezione dell'ambiente. Questo elenco di applicazioni industriali possibili è lungi dall'essere esauriente.
Protezione dei dati	Questa inchiesta è sostenuta dalla SUVA, l'UFSP, l'UFAM, il SECO e l'AFSSET (FR). L'identità della vostra ditta sarà conosciuta solamente dalla SUVA. L' "Institut de Santé au Travail" ha un accordo di confidenzialità con la SUVA. Gli uffici federali riceveranno solo un rapporto reso anonimo.
Ulteriori informazioni	• Rischi della nanotechnologia, http://www.bafu.admin.ch/dokumentation/fokus/00118/index.html?lang=it • Piano d'azione nanoparticelle sintetiche 2006-2009, http://www.bafu.admin.ch/chemikalien/01359/01393/01394/index.html?lang=it • Rapporto della Royal Society per far fronte alla sfida etica, medica e sociale della nanotecnologia (EN), www.nanotec.org.uk/finalReport.htm • Nanotechnology: Small matter, many unknowns? Opuscolo della SwissRe (1MB, EN), www.swissre.com/INTERNET/pwsfilpr.nsf/vwFilebyIDKEYLu/ULUR-65AKZF/$FILE/Publi04_Nano_en.pdf • Punto di vista della SUVA: Nanoparticelle sul lavoro, www.suva.ch/it/home/suvapro/branchenfachthemen/nanopartikel_an_arbeitsplaetzen.htm

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NANO-INVENTARIO: Informazioni di base concernenti la ditta

Questa inchiesta è sostenuta da SUVA, UFSP, UFAM, SECO e AFSSET (FR). **Le informazioni sono sottoposte alla confidenzialità. L'identità della ditta sarà resa nota solo alla SUVA.**

La vostra società (istituto/organizzazione) è stata selezionata per caso tra le società clienti della SUVA. Vi saremo grati se ritornerete il questionario, anche nel caso in cui non avete un'unità di produzione o se l'unità di produzione non è situata in svizzera. Potrete in questo caso compilare soltanto la prima pagina precisando queste informazioni alle domande 7 e 8.

Dati generali sulla ditta

		Non riempire questa colonna
1. Nome della ditta:	1.	1.
2. Indirizzo: (Sede principale)	2.	2.
3. Persona di contatto:	3.	3.
4. Numero di collaboratori (appros.):	4.	4.
5. Numero SUVA (si trova sulla busta):	5. SUVA:	5.
6. Quale è il vostro settore?	6.	6.
7. Avete una produzione propria?	7. a)☐ sì b)☐ no c)☐ Se sì, dove? Numero postale:	7 a 7 b 7 c
8. Osservazioni concernenti i dati generali:	8.	8

Definizione delle nanoparticelle/particelle ultrafini: Le nanoparticelle sono più piccole di 100 nanometri (= 0.1µm). Per questa inchiesta ci interessiamo alle particelle inferiori a 1000 nanometri (= 1µm). **In questo questionario, le chiameremo «particelle sub-micrometriche» (particelle <1µm) o particelle sub/µm** (vedi le ragioni nel foglio «informazioni preliminari»).

Nella vostra ditta producete, utilizzate o liberate delle nanoparticelle?

9. Nelle vostra ditta, le nanoparticelle/particelle ultrafini sono :		9.1a 9.1b
9.1. prodotte?	9.1 a)☐ sì b)☐ no c)☐ non so	9.2a 9.2b
9.2. utilizzate?	9.3 a)☐ sì b)☐ no c)☐ non so	9.3a 9.3b
9.3. liberate durante un processo? (senza combustione né saldatura)		9.3c 9.3d
9.4. previste in futuro?	9.4 a)☐ sì b)☐ no c)☐ non so	9.4a 9.4b

Se non utilizzate nanoparticelle, indicatene per favore la ragione:
☐ nessuna necessità ☐ considerazioni di salute ☐ non conosciute
☐ ragioni tecniche ☐ troppo care ☐ altro; specificare

Se avete spuntato **«no» alle domande da 9.1 a 9.3**, indicando che non utilizzate e non producete nanoparticelle, potete concludere qui il questionario e ritornarlo all' «Institut de Santé au Travail».

Confermo che questo questionario è stato riempito in buona fede.

Riempito da (nome): Funzione: Firma:

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Informazioni di base della ditta con particelle sub/µm

		Non riempire questa colonna
10. Quali sono le strutture gerarchiche che si occupano della sicurezza in relazione con le particelle sub/µm?	10. a)☐ responsabile di linea / produzione b)☐ responsabile della sicurezza / igiene c)☐ direzione d)☐ altro; specificare:	10.a 10.b 10.c 10.d
11. La ditta si è associata a una soluzione settoriale (per rami professionali della CFSL)? Indicare il nome della soluzione	11. a) Numero-CFSL: o nome della soluzione settoriale: (p.es. Federazione tessile svizzera) b)☐ Nessuna soluzione settoriale	11.a 11.b
12. È presente un medico del lavoro o un igienista del lavoro nella vostra ditta?	12.1 medico del lavoro a)☐ sì b)☐ no c)☐ esterno 12.2 igienista del lavoro a)☐ sì b)☐ no c)☐ esterno 12.3 ing. della sicurezza a)☐ sì b)☐ no c)☐ esterno 12.4 incaricato della sicurezza a)☐ sì b)☐ no c)☐ esterno	12.1a 12.1b 12.1c 12.2a 12.2b 12.2c 12.3a 12.3b 12.3c 12.4a 12.4b 12.4c
13. Con che frequenza gli impiegati sono informati sui pericoli potenziali delle nanoparticelle?	13. a)☐ con ogni ordinazione b)☐ ca. 1 volta alla settimana c)☐ ca. 1 volta al mese d)☐ ca. 1 volta all'anno e)☐ altro; specificare f)☐ mai	13.a 13.b 13.c 13.d 13.e 13.f
14. La descrizione tecnica del prodotto contiene delle indicazioni relative alle nanoparticelle?	14. a)☐ sì b)☐ no c) se sì, quali?	14.a 14.b 14.c
15. Quali particelle sub/µm sono usate nella vostra ditta? Date tutte le informazioni disponibili. Esempio: processo: «produzione di vernici» o «verniciatura», prodotto finale: «vernici» o «superfici di mobili». Se manca lo spazio – vogliate usare il verso del foglio. Se usate più di tre tipi di particelle sub/µm – vogliate utilizzare il retro della pagina.	15. a)nome del prodotto 1: b)sostanza della particella: c)nome del processo: d)prodotto finale: e)dimensione media della particella: f) nome del prodotto 2: g)sostanza della particella: h)nome del processo: i) prodotto finale: j) dimensione media della particella: k)nome del prodotto 3: l) sostanza della particella: m)nome del processo: n)prodotto finale: o)dimensione media della particella:	15.a 15.b 15.c 15.d 15.e 15.f 15.g 15.h 15.i 15.j 15.k 15.l 15.m 15.n 15.o
16. Stoccaggio 16.1. Che quantità di nanoparticelle avete in stock (appros.)? 16.2. Che quantità viene consegnata dai vostri fornitori (ad ogni consegna)? 16.3. Qual è la frequenza delle consegne da parte dei forniton? 16.4. Che quantità viene consegnata ai vostri clienti (ad ogni consegna)? 16.5. Con che frequenza è consegnata ai vostri clienti?	Se utilizzate vari tipi di particelle, vogliate specificare la risposta per ogni tipo utilizzando il retro della pagina o aggiungendo una pagina 16.1 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ altro; specificare: 16.2 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ altro; specificare 16.3 a)☐ alla set. b)☐ al mese c)☐ all'anno d)☐ altro; specificare: 16.4 a)☐g b)☐kg c)☐100kg d)☐t e)☐100t f)☐kt g)☐ altro; specificare: 16.5 a)☐ alla set. b)☐ al mese c)☐ all'anno d)☐ altro; specificare:	16.1a 16.1b 16.1c 16.1d 16.1e 16.1f 16.1g 16.2a 16.2b 16.2c 16.2d 16.2e 16.2f 16.2g 16.3a 16.3b 16.3c 16.3d 16.3e 16.4a 16.4b 16.4c 16.4d 16.4e 16.4f 16.4g 16.5a 16.5b 16.5c 16.5d

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Vari processi? Numerare con questo numero: Num:

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Processo di produzione (descrizione del processo di produzione)

*Se avete diversi processi dove sono implicate delle particelle sub/µm fotocopiate questo foglio e compilate un foglio per ogni processo. Solo se **un** processo utilizza vari tipi di particelle sub/µm compilate una volta sola il foglio menzionando i vari tipi di particelle utilizzate sul verso della pagina.*

		Non riempire questa colonna
17. Descrizione del processo (Per es.: produzione di carta fotografica XYZ	17.	17.
18. Particelle utilizzate in questo processo (indicare anche se è di propria fabbricazione):	18. a) nome del prodotto: b) sostanza di base: c) dimensioni medie delle particelle: [nm]	18.
19. In che forma le nanoparticelle si trovano nel vostro processo?	19. a)☐ polvere b)☐ dispersione c)☐ altro; specificare	19a 19b 19c
20. Quantità approssimativa usata ogni anno in questo processo	20. [kg/anno] o [litri/anno] concentrazione [g/litro]	20.
21. Tipo di confezione utilizzato per la consegna dal fornitore:	21. a)☐ bidone b)☐ tank c)☐ corpo solido d)☐ sacco e)☐ big bag f)☐ altro; specificare	21a 21b 21c 21d 21e 21f
22. Vi è uno stock in deposito?	22. a)☐ sì b)☐ no	22a 22b
23. Avvengono dei rovesciamenti?	23. a)☐ sì b)☐ no	23a 23b
24. Durata/frequenza del processo 24.1. Qual è la frequenza del processo? 24.2. Qual è la durata del processo?	24.1 a)☐ all'anno b)☐ alla setimana c)☐ al mese d)☐ altro; specificare 24.2 a)☐ minuti b)☐ ore c)☐ giorni d)☐ altro; specificare	24.1a 24.1b 24.1c 24.1d 24.2a 24.2b 24.2c 24.2d
25. Che tipo di protezione avete preso?	25 a)☐ processo chiuso b)☐ cappa c)☐ captaggio semi aperto: cabina d)☐ protezione completa e)☐ captaggio aperto: aspirazione con cappa o tubo f)☐ maschera g)☐ occhiali h)☐ guanti i)☐ nessuna j)☐ altro; specificare:	25a 25b 25c 25d 25e 25f 25g 25h 25i
26. Aerazione del locale 26.1. Vi è un ricircolo d'aria? 26.2. Se sì, qual è la percentuale di ricircolo? 26.3. Se sì, è filtrata? 26.4. Se sì, qual è il tasso di deposizione? (o classe del filtro)?	26.1 a)☐ sì b)☐ no c)☐ non so 26.2 a)☐ % b)☐ non so 26.3 a)☐ sì b)☐ no c)☐ non so 26.4 il tasso di deposizione è: % o classe del filtro:	26.1a 26.1b 26.1c 26.2a 26.2b 26.3a 26.3b 26.3c 26.4
27. Quante persone sono direttamente implicate nel processo si trovano nello stesso locale del processo?	27. a) numero di persone implicate nel processo: b) numero di persone nello stesso locale: c) di cui circa % uomini e % donne	27.
28. È conosciuta l'esposizione media ai posti di lavoro (indicare i valori conosciuti)?	28. a)☐ no b)☐ polveri alveolari: [µg/m³] c)☐ polveri inalabili: [µg/m³] d)☐ quantità di particelle: [numero/cm³] e)☐ altro; specificare :	28.a 28.b 28.c 28.d 28.e
29. Impatto sull'ambiente 29.1. Vi è un trattamento particolare dei rifiuti in questo processo? 29.2. Vi è un trattamento delle acque di scarico per questo processo? 29.3. Vi è un riciclaggio di materiale all'interno della ditta? 29.4. Vi è una filtrazione dell'aria uscente da questo processo? 29.5. Qual è il tasso di deposizione di questi filtri?	29.1 a)☐ sì b)☐ no c)☐ non so d)☐ nessun rifiuto 29.2 a)☐ sì b)☐ no c)☐ nessuna acqua di scarico in questo processo d)☐ non so 29.3 a)☐ sì b)☐ no c)☐ non so 29.4 a)☐ sì b)☐ no c)☐ non so 29.5 a)il tasso di deposizione è: % b)☐ nessuna filtrazione per l'aria uscente c)☐ non so	29.1a 29.1b 29.1c 29.1d 29.2a 29.2b 29.2c 29.2d 29.3a 29.3b 29.3c 29.4a 29.4b 29.4c 29.5a 29.5b 29.5c

A ritornare entro fine febbraio 2007
all' indirizzo: Institut de Santé au Travail, Rue du Bugnon 19, 1005 Lausanne

Figure 18: Questionnaire in Italian

6.2. Details to the results

6.2.1. Responses to the questionnaire (without text-responses)

Table 6: Presentation of all responses to the questionnaire without text-responses.

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n0	Number of Questionnaire				
n1	Name of the company				
n2	Address of the company				
n3	Contact-Person				
n4	Approximate number of employees				
n5	SUVA-Number				
n6	Economic sector				
n7a	Yes - we have a production	493	676	0.42	57.80
n7b	No - we don't have a production	597	572	0.51	48.93
n7c	Our production is in (postal code)				
n8	Remarks for the basic data of your company?				
n91a	Yes - we produce nanoparticles	10	1159	0.01	99.14
n91b	No - we don't have a production of nanoparticles	1034	135	0.88	11.55
n91c	I don't know if we have a production of nanoparticles	37	1132	0.03	96.83
n92a	Yes - we use nanoparticles	46	1123	0.04	96.07
n92b	No - we don't have a use of nanoparticles	953	216	0.82	18.48
n92c	I don't know if we have a use of nanoparticles	92	1077	0.08	92.13
n93a	Yes - we liberate nanoparticles	18	1151	0.02	98.46
n93b	No - we don't have a liberation of nanoparticles	952	217	0.81	18.56
n93c	I don't know if we have a liberation of nanoparticles	97	1072	0.08	91.70
n94a	Yes it is planned	22	1147	0.02	98.12
n94b	No it is not planned	873	296	0.75	25.32
n94c	I don't know if it is planned	126	1043	0.11	89.22
wn1	No use for nanoparticles	779	390	0.67	33.36
wn2	Concerns about health effects	29	1140	0.02	97.52
wn3	I don't know why	109	1060	0.09	90.68
wn4	Technical reasons	42	1127	0.04	96.41
wn5	To expensive	20	1149	0.02	98.29
wn6	Different			0.00	0.00
un	Is the questionnaire signed?	1119	50	0.96	4.28
wer	Who signed it?			0.00	0.00
fun	What is his/her function?			0.00	0.00
n10a	Production level	25	1144	0.02	97.86
n10b	Management level	31	1138	0.03	97.35
n10c	Security/hygiene level	45	1124	0.04	96.15
n10d	Other level			0.00	0.00
n11a	Yes - business solution (with EKAS No./definition)			0.00	0.00
n11b	No business solution	42	1127	0.04	96.41
n121a	Yes - occupational health practitioner	5	1164	0.00	99.57
n121b	No occupational health practitioner	54	1115	0.05	95.38
n121c	Yes occupational health practitioner, but external	16	1153	0.01	98.63
n122a	Yes - occupational hygienist	5	1164	0.00	99.57
n122b	No occupational hygienist	62	1107	0.05	94.70
n122c	Yes occupational hygienist, but external	3	1166	0.00	99.74
n123a	Yes - security engineer	9	1160	0.01	99.23
n123b	No security engineer	58	1111	0.05	95.04
n123c	Yes - security engineer, but external	3	1166	0.00	99.74
n124a	Yes security agent	59	1110	0.05	94.95
n124b	No security agent	17	1152	0.01	98.55
n124c	Yes security agent, but external	0	1169	0.00	100.00
n13a	Information on each instruction	8	1161	0.01	99.32
n13b	Information approx. 1x per week	1	1168	0.00	99.91
n13c	Information approx. 1x per month	6	1163	0.01	99.49
n13d	Information approx. 1x per year	19	1150	0.02	98.37
n13e	Information differently	0	0		
n13f	No information	27	1142	0.02	97.69
n14a	Yes, there is a indication for the sub/µm particles	21	1148	0.02	98.20
n14b	No, there is no indication for the sub/µm particles	43	1126	0.04	96.32
n14c	Yes, the indication is the following				
n15a	Product name1				
n15b	Particle substance1				
n15c	Description of process1				
n15d	Final product1				
n15e	Average of particle size1				
n15f	Product name2				
n15g	Particle substance2				
n15h	Description of process2				
n15i	Final product2				
n15j	Average of particle size2				
n15k	Product name3				
n15l	Particle substance3				
n15m	Description of process3				
n15n	Final product3				

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n15o	Average of particle size3				
n161a	Stock is around a gram (g)	10	1159	0.01	99.14
n161b	Stock is around kilogram (kg)	7	1162	0.01	99.40
n161c	Stock is around hundred kilos (100kg)	10	1159	0.01	99.14
n161d	Stock is around a tonne (t)	11	1158	0.01	99.06
n161e	Stock is around hundred tonnes (100t)	2	1167	0.00	99.83
n161f	Stock is around a kilo-tonne (kt)	1	1168	0.00	99.91
n161g	Stock is differently, it is…				
n162a	Supply is around a gram (g)	6	1163	0.01	99.49
n162b	Supply is around kilogram (kg)	8	1161	0.01	99.32
n162c	Supply is around hundred kilos (100kg)	10	1159	0.01	99.14
n162d	Supply is around a tonne (t)	8	1161	0.01	99.32
n162e	Supply is around hundred tonnes (100t)	1	1168	0.00	99.91
n162f	Supply is around a kilo-tonne (kt)	0	1169	0.00	100.00
n162g	Supply is differently, it is…				
n163a	Frequency of supply is around 1x per week	6	1163	0.01	99.49
n163b	Frequency of supply is around 1x per month	12	1157	0.01	98.97
n163c	Frequency of supply is around 1x per year	13	1156	0.01	98.89
n163d	Frequency of supply is different, it is…				
n164a	Delivery is around a gram (g)	10	1159	0.01	99.14
n164b	Delivery is around kilogram (kg)	3	1166	0.00	99.74
n164c	Delivery is around hundred kilos (100kg)	4	1165	0.00	99.66
n164d	Delivery is around a tonne (t)	3	1166	0.00	99.74
n164e	Delivery is around hundred tonnes (100t)	0	1169	0.00	100.00
n164f	Delivery is around a kilo-tonne (kt)	1	1168	0.00	99.91
n164g	Delivery is differently, it is…	0	0		
n165a	Frequency of delivery is around 1x per week	3	1166	0.00	99.74
n165b	Frequency of delivery is around 1x per month	7	1162	0.01	99.40
n165c	Frequency of delivery is around 1x per year	3	1166	0.00	99.74
n165d	Frequency of delivery is different, it is…				
nr	Process number				
n17	Description of process				
n18a	Product name of the used nanoparticles				
n18b	Substance of the particles				
n18c	Average size of particles [nm]				
n19a	In form of powder	30	1139	0.03	97.43
n19b	In form of a dispersion/liquid	26	1143	0.02	97.78
n19c	Other form, it is…				
n20	Volume of turnover [kg/year] / [l/year] (g/L)	43	1126	0.00	0.96
n21a	Supply in a barrel	10	1159	0.01	99.14
n21b	Supply in a tank	6	1163	0.01	99.49
n21c	Supply as solid	1	1168	0.00	99.91
n21d	Supply in a bag	22	1147	0.02	98.12
n21e	Supply in a big-bag	4	1165	0.00	99.66
n21f	Supply is differently, it is…				
n22a	Yes, we have a intermediate stock	25	1144	0.02	97.86
n22b	No, we don't have an intermediate stock	26	1143	0.02	97.78
n23a	Yes, there is a decanting	34	1135	0.03	97.09
n23b	No, we don't have a decanting	19	1150	0.02	98.37
n241a	Process once a day	17	1152	0.01	98.55
n241b	Process once a week	10	1159	0.01	99.14
n241c	Process once a month	10	1159	0.01	99.14
n241d	Frequency of process is differently, it is…				
n242a	Process takes minutes	22	1147	0.02	98.12
n242b	Process takes hours	26	1143	0.02	97.78
n242c	Process takes weeks	0	1169	0.00	100.00
n242d	Duration of process differently, it is…				
n25a	Closed process as a protection	13	1156	0.01	98.89
n25b	Chapel/capsule/enclosure as a protection	16	1153	0.01	98.63
n25c	Half-open aspiration	14	1155	0.01	98.80
n25d	Open aspiration	22	1147	0.02	98.12
n25e	Fully closed personal protective clothing	5	1164	0.00	99.57
n25f	Breathing protection	33	1136	0.03	97.18
n25g	Glasses	40	1129	0.03	96.58
n25h	Gloves	41	1128	0.04	96.49
n25i	No protection measures	5	1164	0.00	99.57
n25j	Protection measures differently, they are…				
n261a	Yes, there is an air recirculation	12	1157	0.01	98.97
n261b	No, there is no air recirculation	39	1130	0.03	96.66
n261c	I don't know if there is an air recirculation	4	1165	0.00	99.66
n262a	Yes, the recirculation is …	3	1166	0.00	99.74
n262b	I don't know what is the recirculation rate	16	1153	0.01	98.63
n263a	Yes, the air is filtered	16	1153	0.01	98.63
n263b	No, the air is not filtered	9	1160	0.01	99.23
n263c	I don't know if the air is filtered	5	1164	0.00	99.57
n264	The filtration efficiency is… [%]				
n27a	Number of involved persons in the process				
n27b	Number of persons in the same room				
n27c1	Masculine [%]				
n27c2	Feminine [%]				
n28a	Average is not known	45	1124	0.04	96.15

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n28b	Inhalable dust fraction (a-dust): [µg/m3]				
n28c	Respirable dust (e-dust): [µg/m3]				
n28d	Number concentration [number/cm3]				
n28e	Average is differently, it is…				
n291a	Yes, there is a waste treatment in this process	27	1142	0.02	97.69
n291b	No, there is no waste treatment in this process	13	1156	0.01	98.89
n291c	I don't know if there is a waste treatment in this process	3	1166	0.00	99.74
n291d	No, there is no wastes in this process	13	1156	0.01	98.89
n292a	Yes, there is a pre-treatment of the effluent	12	1157	0.01	98.97
n292b	No, there is no pre-treatment of the effluent	19	1150	0.02	98.37
n292c	I don't know if there is a pre-treatment	2	1167	0.00	99.83
n292d	There are no effluents in this process	19	1150	0.02	98.37
n293a	Yes, we have a recycling	17	1152	0.01	98.55
n293b	No, there is no recycling	32	1137	0.03	97.26
n293c	I don't know if there is a recycling	1	1168	0.00	99.91
n294a	Yes, the exhaust air is filtered	24	1145	0.02	97.95
n294b	No, the exhaust air is not filtered	25	1144	0.02	97.86
n294c	I don't know if the exhaust air is filtered	4	1165	0.00	99.66
n295a	The filtration efficiency is… [%]	4	1165	0.00	99.66
n295b	We don't have filters for the exhaust air	10	1159	0.01	99.14
n295c	I don't know what is the filtration efficiency	28	1141	0.02	97.60

Table 7: Presentation of the responses to the layered survey without text-responses.

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n0	Number of Questionnaire				
n1	Name of the company				
n2	Address of the company				
n3	Contact-Person				
n4	Approximate number of employees				
n5	SUVA-Number				
n6	Economic sector				
n7a	Yes - we have a production	351	604	36.75%	63.25%
n7b	No - we don't have a production	541	414	56.65%	43.35%
n7c	Our production is in (postal code)				
n8	Remarks for the basic data of your company?				
n91a	Yes - we produce nanoparticles	0	955	0.00%	100.00%
n91b	No - we don't have a production of nanoparticles	851	104	89.11%	10.89%
n91c	I don't know if we have a production of nanoparticles	33	922	3.46%	96.54%
n92a	Yes - we use nanoparticles	18	937	1.88%	98.12%
n92b	No - we don't have a use of nanoparticles	794	161	83.14%	16.86%
n92c	I don't know if we have a use of nanoparticles	81	874	8.48%	91.52%
n93a	Yes - we liberate nanoparticles	5	950	0.52%	99.48%
n93b	No - we don't have a liberation of nanoparticles	786	169	82.30%	17.70%
n93c	I don't know if we have a liberation of nanoparticles	80	875	8.38%	91.62%
n94a	Yes it is planned	6	949	0.63%	99.37%
n94b	No it is not planned	754	201	78.95%	21.05%
n94c	I don't know if it is planned	80	875	8.38%	91.62%
wn1	No use for nanoparticles	647	308	67.75%	32.25%
wn2	Concerns about health effects	25	930	2.62%	97.38%
wn3	I don't know why	101	854	10.58%	89.42%
wn4	Technical reasons	27	928	2.83%	97.17%
wn5	To expensive	7	948	0.73%	99.27%
wn6	Different				
un	Is the questionnaire signed?	915	40	95.81%	4.19%
wer	Who signed it?	0	0		
fun	What is his/her function?	0	0		
n10a	Production level	7	948	0.73%	99.27%
n10b	Management level	19	936	1.99%	98.01%
n10c	Security/hygiene level	15	940	1.57%	98.43%
n10d	Other level				
n11a	Yes - business solution (with EKAS No./definition)				
n11b	No business solution	25	930	2.62%	97.38%
n121a	Yes - occupational health practitioner	1	954	0.10%	99.90%
n121b	No occupational health practitioner	32	923	3.35%	96.65%
n121c	Yes occupational health practitioner, but external	5	950	0.52%	99.48%
n122a	Yes - occupational hygienist	1	954	0.10%	99.90%
n122b	No occupational hygienist	32	923	3.35%	96.65%
n122c	Yes occupational hygienist, but external	0	955	0.00%	100.00%
n123a	Yes - security engineer	2	953	0.21%	99.79%
n123b	No security engineer	30	925	3.14%	96.86%
n123c	Yes - security engineer, but external	1	954	0.10%	99.90%
n124a	Yes security agent	20	935	2.09%	97.91%
n124b	No security agent	17	938	1.78%	98.22%
n124c	Yes security agent, but external	0	955	0.00%	100.00%
n13a	Information on each instruction	2	953	0.21%	99.79%
n13b	Information approx. 1x per week	1	954	0.10%	99.90%
n13c	Information approx. 1x per month	4	951	0.42%	99.58%
n13d	Information approx. 1x per year	9	946	0.94%	99.06%
n13e	Information differently				
n13f	No information	20	935	2.09%	97.91%
n14a	Yes, there is a indication for the sub/µm particles	5	950	0.52%	99.48%
n14b	No, there is no indication for the sub/µm particles	27	928	2.83%	97.17%
n14c	Yes, the indication is the following				
n15a	Product name1				
n15b	Particle substance1				
n15c	Description of process1				
n15d	Final product1				
n15e	Average of particle size1				
n15f	Product name2				
n15g	Particle substance2				
n15h	Description of process2				
n15i	Final product2				
n15j	Average of particle size2				
n15k	Product name3				
n15l	Particle substance3				
n15m	Description of process3				
n15n	Final product3				
n15o	Average of particle size3				
n161a	Stock is around a gram (g)	2	953	0.21%	99.79%
n161b	Stock is around kilogram (kg)	2	953	0.21%	99.79%

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n161c	Stock is around hundred kilos (100kg)	6	949	0.63%	99.37%
n161d	Stock is around a tonne (t)	4	951	0.42%	99.58%
n161e	Stock is around hundred tonnes (100t)	0	955	0.00%	100.00%
n161f	Stock is around a kilo-tonne (kt)	0	955	0.00%	100.00%
n161g	Stock is differently, it is…				
n162a	Supply is around a gram (g)	2	953	0.21%	99.79%
n162b	Supply is around kilogram (kg)	2	953	0.21%	99.79%
n162c	Supply is around hundred kilos (100kg)	7	948	0.73%	99.27%
n162d	Supply is around a tonne (t)	2	953	0.21%	99.79%
n162e	Supply is around hundred tonnes (100t)	0	955	0.00%	100.00%
n162f	Supply is around a kilo-tonne (kt)	0	955	0.00%	100.00%
n162g	Supply is differently, it is…				
n163a	Frequency of supply is around 1x per week	2	953	0.21%	99.79%
n163b	Frequency of supply is around 1x per month	5	950	0.52%	99.48%
n163c	Frequency of supply is around 1x per year	6	949	0.63%	99.37%
n163d	Frequency of supply is different, it is…				
n164a	Delivery is around a gram (g)	4	951	0.42%	99.58%
n164b	Delivery is around kilogram (kg)	1	954	0.10%	99.90%
n164c	Delivery is around hundred kilos (100kg)	2	953	0.21%	99.79%
n164d	Delivery is around a tonne (t)	2	953	0.21%	99.79%
n164e	Delivery is around hundred tonnes (100t)	0	955	0.00%	100.00%
n164f	Delivery is around a kilo-tonne (kt)	0	955	0.00%	100.00%
n164g	Delivery is differently, it is…	0	0		
n165a	Frequency of delivery is around 1x per week	1	954	0.10%	99.90%
n165b	Frequency of delivery is around 1x per month	2	953	0.21%	99.79%
n165c	Frequency of delivery is around 1x per year	2	953	0.21%	99.79%
n165d	Frequency of delivery is different, it is…				
nr	Process number				
n17	Description of process				
n18a	Product name of the used nanoparticles				
n18b	Substance of the particles				
n18c	Average size of particles [nm]				
n19a	In form of powder	13	942	1.36%	98.64%
n19b	In form of a dispersion/liquid	7	948	0.73%	99.27%
n19c	Other form, it is…				
n20	Volume of turnover [kg/year] / [l/year] (g/L)	19	936	1.99%	98.01%
n21a	Supply in a barrel	3	952	0.31%	99.69%
n21b	Supply in a tank	0	955	0.00%	100.00%
n21c	Supply as solid	0	955	0.00%	100.00%
n21d	Supply in a bag	10	945	1.05%	98.95%
n21e	Supply in a big-bag	0	955	0.00%	100.00%
n21f	Supply is differently, it is…				
n22a	Yes, we have a intermediate stock	8	947	0.84%	99.16%
n22b	No, we don't have an intermediate stock	13	942	1.36%	98.64%
n23a	Yes, there is a decanting	15	940	1.57%	98.43%
n23b	No, we don't have a decanting	7	948	0.73%	99.27%
n241a	Process once a day	6	949	0.63%	99.37%
n241b	Process once a week	5	950	0.52%	99.48%
n241c	Process once a month	4	951	0.42%	99.58%
n241d	Frequency of process is differently, it is…				
n242a	Process takes minutes	8	947	0.84%	99.16%
n242b	Process takes hours	11	944	1.15%	98.85%
n242c	Process takes weeks	0	955	0.00%	100.00%
n242d	Duration of process differently, it is…				
n25a	Closed process as a protection	4	951	0.42%	99.58%
n25b	Chapel/capsule/enclosure as a protection	1	954	0.10%	99.90%
n25c	Half-open aspiration	4	951	0.42%	99.58%
n25d	Open aspiration	10	945	1.05%	98.95%
n25e	Fully closed personal protective clothing	3	952	0.31%	99.69%
n25f	Breathing protection	12	943	1.26%	98.74%
n25g	Glasses	13	942	1.36%	98.64%
n25h	Gloves	13	942	1.36%	98.64%
n25i	No protection measures	4	951	0.42%	99.58%
n25j	Protection measures differently, they are…				
n261a	Yes, there is an air recirculation	6	949	0.63%	99.37%
n261b	No, there is no air recirculation	16	939	1.68%	98.32%
n261c	I don't know if there is an air recirculation	1	954	0.10%	99.90%
n262a	Yes, the recirculation is …in [%]	1	954	0.10%	99.90%
n262b	I don't know what is the recirculation rate	8	947	0.84%	99.16%
n263a	Yes, the air is filtered	8	947	0.84%	99.16%
n263b	No, the air is not filtered	4	951	0.42%	99.58%
n263c	I don't know if the air is filtered	0	955	0.00%	100.00%
n264	The filtration efficiency is… [%]				
n27a	Number of involved persons in the process				
n27b	Number of persons in the same room				
n27c1	Masculine [%]				
n27c2	Feminine [%]				
n28a	Average is not known	17	938	1.78%	98.22%
n28b	Inhalable dust fraction (a-dust): [µg/m3]				
n28c	Respirable dust (e-dust): [µg/m3]				
n28d	Number concentration [number/cm3]				

ID	Translated question	Count: "CROSS"	Count: "NO CROSS"	%Cross	%NO Cross
n28e	Average is differently, it is…				
n291a	Yes, there is a waste treatment in this process	10	945	1.05%	98.95%
n291b	No, there is no waste treatment in this process	6	949	0.63%	99.37%
n291c	I don't know if there is a waste treatment in this process	0	955	0.00%	100.00%
n291d	No, there is no wastes in this process	5	950	0.52%	99.48%
n292a	Yes, there is a pre-treatment of the effluent	2	953	0.21%	99.79%
n292b	No, there is no pre-treatment of the effluent	8	947	0.84%	99.16%
n292c	I don't know if there is a pre-treatment	0	955	0.00%	100.00%
n292d	There are no effluents in this process	7	948	0.73%	99.27%
n293a	Yes, we have a recycling	7	948	0.73%	99.27%
n293b	No, there is no recycling	6	949	0.63%	99.37%
n293c	I don't know if there is a recycling	14	941	1.47%	98.53%
n294a	Yes, the exhaust air is filtered	0	955	0.00%	100.00%
n294b	No, the exhaust air is not filtered	11	944	1.15%	98.85%
n294c	I don't know if the exhaust air is filtered	10	945	1.05%	98.95%
n295a	The filtration efficiency is…	0	955	0.00%	100.00%
n295b	We don't have filters for the exhaust air	5	950	0.52%	99.48%
n295c	I don't know what is the filtration efficiency	10	945	1.05%	98.95%